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March 21, 1929

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# Engineering News-Record

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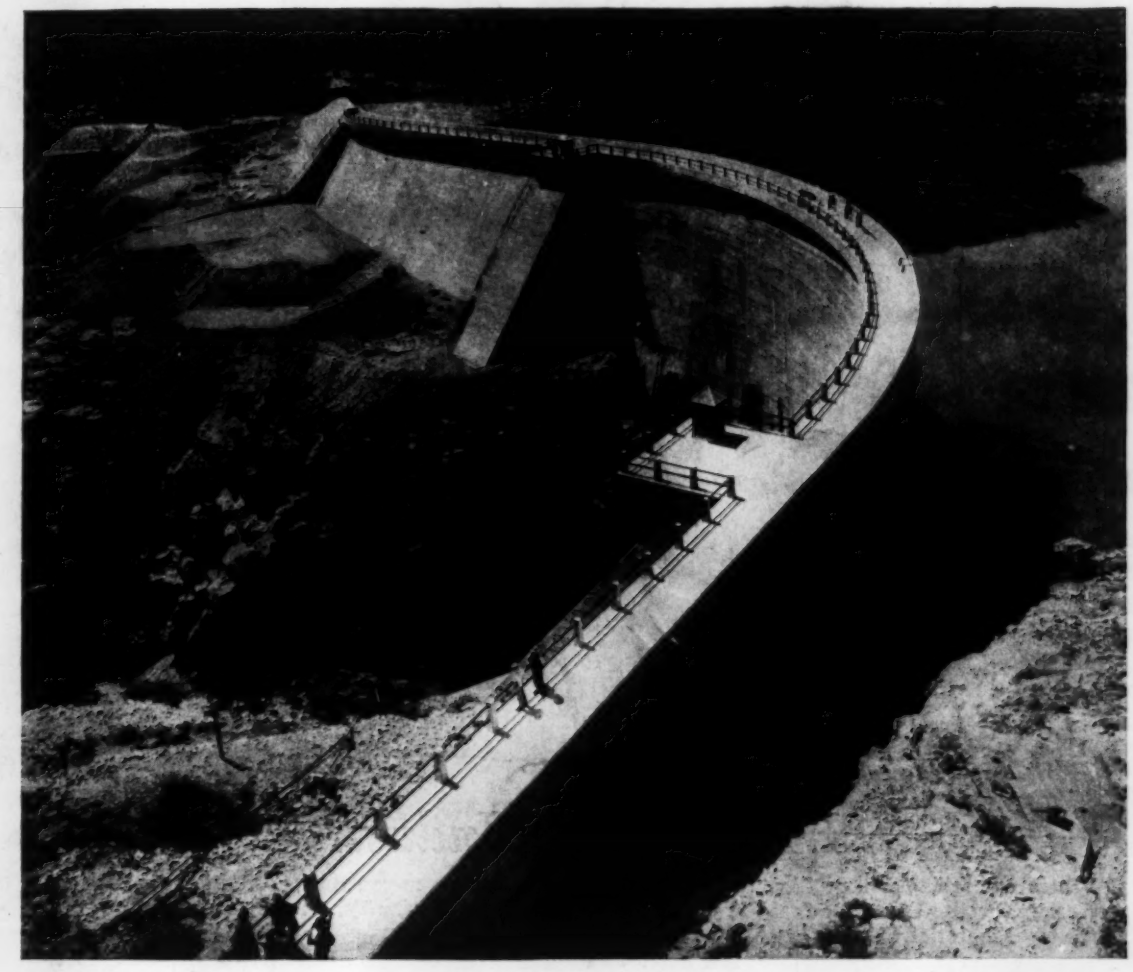

The Calles Dam, Mexico

Recent Irrigation Developments in Mexico . . . Contraction-Joint Treatment in Pardee Dam . . . Welding—A New Tool for the Structural Fabricator . . . Present Status of Boulder Canyon Project . . . The Airport at Rome . . . Economic Features in Design of Sewage Systems . . . Continuous Beam Design Practice Brought Up to Date . . . Field-Welded Pipe Hung on Canyon Wall . . . Hand and Machine-Spread Asphalt Costs

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## *Construction's Power Factor*

AN ANALYSIS of equipment, painting in broad strokes the problems and progress in mechanizing construction, is to be the theme of *Engineering News-Record* two weeks hence. Ten years ago there would have been much less need for such an issue. But today the contractor's rôle as a labor boss is over and jobs are gaged by their horsepower instead of their man power. This means a wholly new set of problems for the contractor and the engineer. Briefly, the former must not only change from a labor boss to an equipment user, he must operate his equipment with the astuteness of a chess player; both contractor and engineer need constantly to know the most profitable methods of utilizing construction's growing power factor.

IT IS the purpose of the Equipment Issue to assist the engineer and the contractor in their appraisal of this power factor in construction. What advances in equipment have been made? Is installment buying of equipment sound? What is the effect of mechanization on bidding practices? Where is the field for the diesel engine? These questions are to be answered by authorities of recognized standing.

MORE profitable progress is possible by a wider appreciation of construction's power factor. There is a message for every engineer and contractor in the

***Equipment Issue, April 4***

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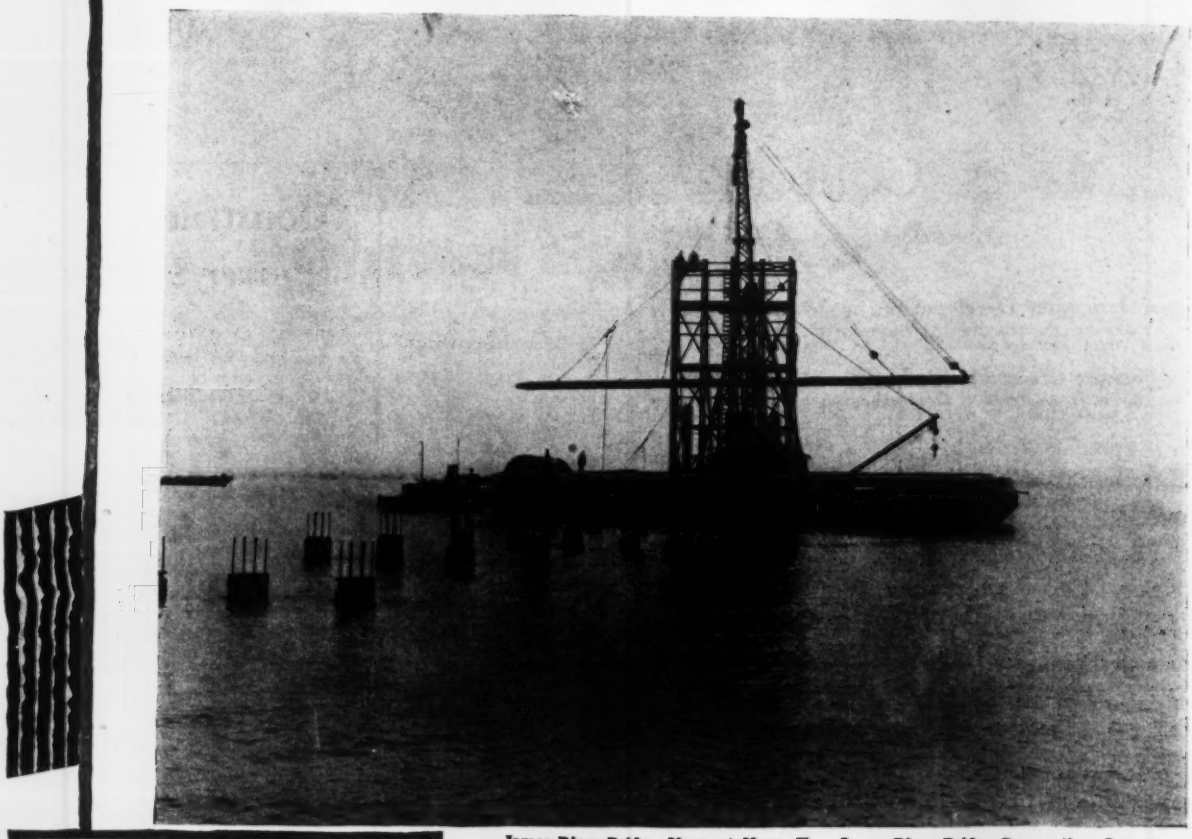

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Volume 102 NEW YORK, MARCH 21, 1929 Number 12

## *Floods in the South*

LAST week's floods in southern Alabama, large as they figure in the day's news, do not reveal any new menace of Nature but merely manifest once more the hazard residing in every stream valley. They resulted from unusually heavy rainfall coming at the close of four weeks of rain, yet nothing beyond well-recognized possibilities for the South Atlantic and Gulf region. Thus they add another instance to a long history of local floods, for not a year goes by without a destructive flood in one or another part of the country, where rainfall and runoff for the moment combine in slightly more unfavorable manner than usual. In almost every instance it is found after the event that the great flood could readily have been foreseen as a possibility—as something not likely to happen oftener than once in twenty or fifty years, perhaps, or even a hundred or more, but to that extent probable. Protection is always possible, either by keeping human habitations and communications out of the path of the water or by building flood-restraining works, but only in a few instances have men been willing to provide such protection, even after the event. Still more rarely have they been forehanded enough to make flood studies before the event and take steps to prevent the destruction that some future day might bring. The problem often is beyond the power of a local community, of course. It is a natural duty of the state government, which can command the necessary information and has power to keep its citizens from building below flood level. But the states have yet to acknowledge the obligation.

## *Inevitable Development*

DEVELOPMENT of the St. Lawrence River for both power and navigation has been advanced definitely through the recent approval by the Canadian government of plans of the Beauharnois Light, Heat & Power Company for the construction of a power plant on the Canadian section of the St. Lawrence River. The power company proposes to construct a canal to divert water for power purposes from Lake St. Francis to Lake St. Louis. In approving the plans the Canadian government laid the foundation for the development of another section of the river for deep-draft vessels by stipulating that the power canal be of such width and depth and its rate of flow of such a character as to permit of its use as a navigation canal in the future; also by requiring the power company to carry out all its work with that idea in view. What the Canadian government has done in this instance will inevitably be done in every other instance of power development on the St. Lawrence River. Neither the Canadian government nor the government of the United States will permit the construction of dams or canals without provision for a greater waterway than the one by which small vessels now go up and down the St. Lawrence River between Montreal and the Great Lakes. No one can doubt that the major power sites on the St. Lawrence River will be developed before many years go by. As each section of the river is so developed, conversion of the entire river into a channel for large vessels will be brought nearer and nearer until it reaches a stage where the construction of a few locks and a certain amount of dredging and side canal construction will be all that stands between the present shallow canal and one for deep-draft vessels. When that stage is reached, completion of the St. Lawrence deep waterway will be inevitable.

## *Unified Sanitation*

BETTER service at less cost in the disposal of the sewage, garbage and other refuse of New York and in street cleaning is promised by the bill creating a sanitary department for the entire city, now before the New York Legislature. For years the responsibility for sewage disposal has been divided among five borough presidents, and that for street cleaning and waste disposal has been assigned in two boroughs to the presidents and in the three other boroughs to the centralized department of street cleaning. This scattering of function is illogical from every viewpoint except division of patronage, and leads to both sanitary and financial inefficiency. Whatever justification there may have been for borough autonomy when the Greater New York charter was adopted thirty years ago, it does not now and never did apply to the services in question. It has brought about notorious graft in at least one borough, hampered contracting and financial control by the central administration, and delayed progress in providing adequate means of final disposal of the city's huge volumes of sewage, garbage, ashes and miscellaneous refuse. Borough autonomy has spelled inefficiency for the city as a whole. Strange to say, the borough president who led in exposing sewer scandals before he took office recently and who since then has pressed charges of both sewer and street cleaning graft, is against centralized sanitation. For the good of the city's sanitation, however, the bill should become law.

## *A Mexican Attempt*

MATTERS of interesting significance are developing in Mexico—not the civil-war interlude of the current month, but the irrigation development that has been in progress for several years and with reasonable luck will continue for many years more. Considered only as water and land utilization and the construction of dams and canals, it contains little more than local differences from similar work here or abroad; but as a systematic attempt to develop an independent farmer class by the help of engineering works it is decidedly different from government reclamation in the United States. The general scheme is based on complete separation of financing and land management from the engineering operations of building the works. No such separation was provided in

our reclamation act, and its importance to the success of irrigation was not understood when that act was written, in 1902. The checkered fortunes of reclamation in the United States resulted in large part from the merging of two basically distinct responsibilities. Accordingly, it will be of great interest to see how the Mexican experiment works out. The idea of placing the financial and administrative problems of bringing irrigated land into production under a businesslike sales-and-service organization is a wise one. Its adoption offers substantial promise for successful owner operation of small farms.

### *Money Saved*

POSSIBLE economies in sewerage construction cost through careful study of layout of lateral, main and trunk sewers by districts are well illustrated by an article elsewhere in this issue. Eight possible layouts for a flat area of one square mile are illustrated, and attention is called to a variety of conditions affecting cost in both flat and hilly districts. In the latter, topography may govern so completely that only one layout is feasible, but that is not likely to occur often and then might apply more to the trunk sewer than to laterals. As the author well says, such studies take time, but they may return dividends a thousand-fold. This is not likely to be appreciated by the average city father unless it is forcibly brought to his attention. The article should be a direct aid in that respect as well as a stimulus to similar studies and publication of results by other engineers.

## *Asphalt-Finishing by Machine*

QUANTITATIVE evidence of the success of machine-finishing asphalt roads is being rapidly recorded. In the issue of March 7 and again in this issue specific records are given of increased density, increased speed of production and decreased cost. With virtually only two years of considerable use, machine finishing has established itself not only as practicable but as a money- and time-saving method of performing mechanically about the only remaining manual process in asphalt paving. As yet the machine operation exhibits the vagaries in plant and procedure inseparable from the infancy of a new practice, but the soundness of the offspring that is being nurtured seems certain.

At present there appear to be only two main questions in the machine design: Is a raking attachment essential, or may we expect adequate results from the simpler machine having screed action alone? Is a heating device for the screed an essential machine element, or is the requirement for heating so occasional that it can be well enough met by a separate torch? Obviously the less additional mechanism there is to encumber the present surface finishing machine—already about as heavy as can be easily handled—the more useful the asphalt finisher will be. Aside from modification of the machine itself there is a problem of adjusting the remaining plant to the machine.

Almost every operation of which there is record discloses lack of co-ordination of the other plant elements with the finishing machine. This is natural, since generally the new device has been grafted on a plant adjusted to the speed of hand finishing. It is not reasonable, however, that the condition should continue. There must be a capacity increase in the mixing plant and the hauling equipment corresponding to the greater placement possibilities of the finishing machine. Here is where actual records such as are given in the articles previously referred to have constructive value. They should be the well-advised conclusions of engineers, obviously, rather than the star-performance figures of equipment salesmen. An asphalt roadbuilding plant is at its least estimate too heavy an investment to be extended on any basis other than the most reliable figures of the placement ability of the finishing machine.

There has been continually increasing occasion to note the true professional engineering attitude of mind which equipment manufacturers have assumed in recent years in working out equipment-engineering problems. In developing the practice of asphalt laying by machine they have a particularly imminent task of true engineering character which they can perform, or at least in the performance of which they can be an ever-present help. In the various "inventions" that are coming up in asphalt-finishing devices there is need of the stabilizing influence of engineers grounded in the practicalities of enduring design, which is essentially different from inventors' inspiration.

## *Alteration Hazards*

HAZARDS of a special kind are involved in the alteration of old buildings, and as this class of work becomes increasingly common they deserve careful thought. These hazards lie in the unknown condition and sometimes the unsuspected deterioration of the parts of the building. Experience has shown by repeated examples what serious results may follow from these conditions; yet the risk is not always recognized by those who design, execute or supervise the work.

Changing requirements of tenancy may demand, for example, that in a structure having masonry bearing walls and therefore small windows the window space shall be enlarged by inserting columns and lintels and taking out part of the walls in the lower stories. In other cases extensive interior alterations are called for, involving the removal of old structural members and the substitution of new ones. In all such work a detailed study of the structural character of the old building is an essential prerequisite.

There is the question of the adequacy of the old frame in point of strength and relation to the proposed alterations, which may affect both amount and distribution of load. In the second place, there is the question of physical condition, a question which it is almost impossible to answer completely without practically wrecking the structure. Earlier alterations in the building and their relation to the original design and to the proposed alterations may have to be reckoned with. Examination of a Chicago building a few years ago, for example, revealed the unpleasant fact that in earlier alterations some interior wind bracing and other parts of the framing had been cut away to make room for new doorways and other arrangements.

Alteration accidents are fortunately not numerous, yet they point out a wide diversity of potential hazards. One of the most serious accidents due to building alteration was the fall of the Kimberley paper mill in Wisconsin, where new columns were placed over openings in a foundation wall which had been assumed to be solid. The collapse of the Chicago Club building, noted in *Engineering News-Record* of Nov. 8, 1928, was directly due to failure of an old foundation, but the wreckage disclosed some beam connections so corroded that if the defective

foundation had not failed they might have remained in the rehabilitated building as potential causes of a later and more disastrous failure.

In addition to thorough preliminary examination and study a corresponding degree of care is essential in the carrying out of alterations. Conditions set up temporarily in the progress of the work are quite apt to be more dangerous than those existing in either the old or the remodeled structure. Construction loads may be imposed on parts not designed to carry them, the stability of the structure may be reduced by the removal of members, or serious strains may be introduced in the process of replacement. These risks call for as much watchfulness as the design of the alterations themselves, and in addition demand painstaking care and insight during the progress of the work. Nothing may be taken for granted in such undertakings, if safety is to be assured.

That some accidents, as the one at Chicago, cause no loss of life or even personal injury tends to make them less conspicuous and less influential as warnings of the hazards here discussed. Moreover, building codes usually are almost silent on the subject of alterations, and supervision by public authorities is apt to be correspondingly superficial. It is the more essential, then, that engineers, architects and contractors take heed of the hazards inherent in dealing with old buildings.

## Arch Study and Practice

EPOCHMAKING beginnings of a new study of massive arches have been made during the past few years. They promise to lead far and to revivify thinking in this very old field to a degree which may change existing practice extensively. Experiments by the arch committee of the American Socety of Civil Engineers, drawing-table model experiments, large-scale model tests, and finally, measurements on full-sized arch bridges in North Carolina and Georgia, are the chief factors in opening up these new horizons. The engineer's art in the field of arches is in the most flourishing condition of development that it has seen for decades.

Chief among the gains achieved through the recent study are a convincing proof of elastic action in both single and multiple arches, a gratifyingly close check of practical facts with theoretical analyses, a better understanding of temperature action, and above all, a definite and quite practical grasp of the surprising effect of continuity of structure existing in the assemblage of arch ribs and superstructure. Light has also been thrown upon the effect of pier deformations in modifying arch stresses. An interesting fact brought out in the most recent study the measurement of motions and stresses in a full-sized bridge arch in Georgia, is that the temperature conditions in a concrete arch during its construction are such that all subsequent temperature effects correspond to cooling and that therefore the calculation of temperature stresses in an arch rib need not take account of temperature extension but on the other hand must take account of temperature shortening corresponding to the full instead of the half range of temperature. It is clear that this observation will have an important bearing on the proportioning and the safe design of arch bridges.

Of these developments, all of which are obviously significant, the most far-reaching is the study of deck participation. Though first attention was drawn to this point by European engineers, its fullest study and demonstration has been accomplished in the American studies noted. It was established by Prof. George E. Beggs through deformation measurements on sheet celluloid models of a foot or two in span; by Prof. W. M. Wilson through beautifully conducted load tests on concrete arch ribs of 17½-ft. span; and finally by the North Carolina arch test committee through its elaborate load tests in full size on a bridge span of 146 ft.

According to the results of all these studies, the arch rib does not act alone, but forms a unit with the spandrel columns and deck in resisting the deforming action of the load. This being so, our long-established view of division of function between arch rib and superstructure falls to the ground, and methods of analysis as well as methods of design require prompt revision. This is not merely a matter of economy, but also one of safety, for, as the tests of Professor Wilson made evident, the columns and deck may be destroyed by the participation stresses which they are required to carry, even though the arch rib itself would survive under a much higher load. In other words, unless the entire arch structure is designed with due regard for the composite action, it may be made less safe than before, even though it is strengthened—a paradox which calls for shrewd and careful designing.

It now becomes a question of great interest to find out what use will be made of the new results by engineering practice. In simple terms, the effect of the deck participation is to make the arch more rigid, and this is not altogether a desirable effect, since excessive rigidity in an arch may make the temperature stresses critical. If it is decided, however, that greater rigidity in arch structure is advantageous, it then remains to determine whether this rigidity is most effectively attained by the incidental use of the superstructure or by suitable design of the arch itself for rigidity. The composite arch is in effect a spandrel-braced arch, in which the columns and decks serve as spandrel bracing; but as ordinarily designed they are quite inefficient means for this purpose. Spandrel-braced arches of more efficient form can no doubt be devised. Accordingly, if spandrel bracing is concluded to be desirable, it may turn out that the proper procedure is to design an efficient spandrel-braced arch, without regard to its simultaneous service as a deck, and then to design a superstructure and deck which is efficient for its own functioning without regard to joint service as part of the arch. The solution of this problem remains as a piece of work for the practical bridge designer to carry out.

Another problem placed before the arch designer as a result of these developments is that of adequate expansion provisions. The tests cited have brought into view the inadequacy of expansion provisions commonly made. Not only do they fail to assure free temperature expansion of the superstructure but also they are likely to be inadequate to allow for the necessary movement of the deck resulting from the arch distortion. It follows that expansion provision in decks must be computed on a more ample basis and that the devices intended to allow for this expansion movement require redesign in order that they may surely perform the intended function.

Unquestionably there is much further study to be carried on in connection with arches, and it is to be hoped that the investigative work so brilliantly begun will continue. At the same time, however, it has already progressed far enough to point out immediate tasks for the practical bridge designer. In the interests of efficient engineering they should be taken in hand soon.

# Recent Irrigation Developments in Mexico

## Rainfall and Topographic Conditions—Development Under Law of 1926—The Nueva Espana Project—Earth Dam With Concrete Spillway Formed by Bulb-Headed Buttresses—Provision for Hydraulic Jump

By Vincent Saucedo
*Civil Engineer, Mexico City, Mexico*

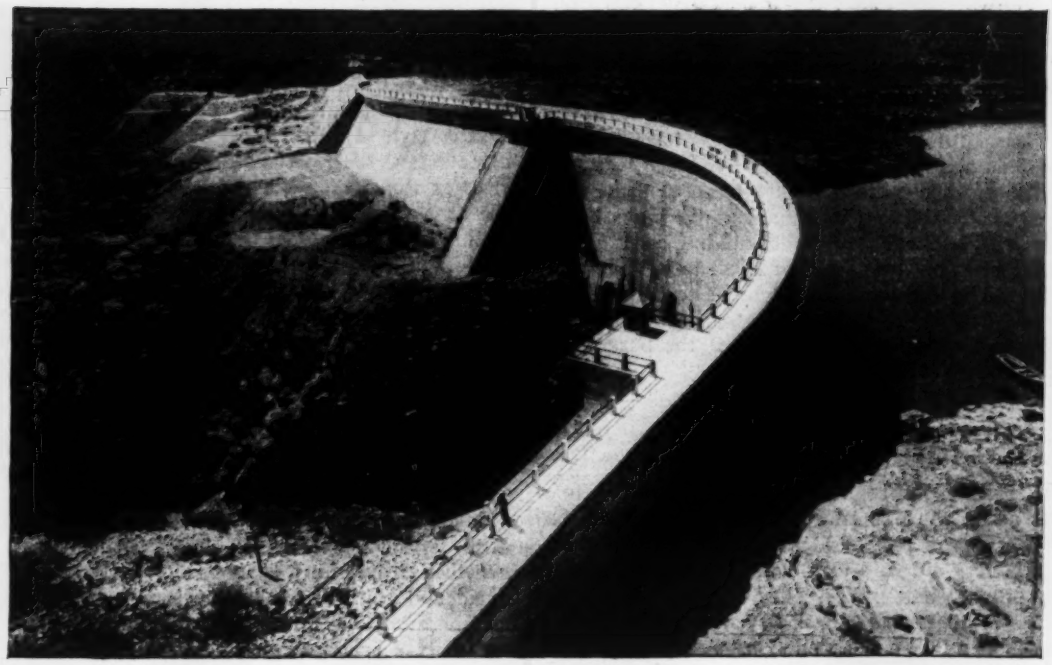


FIG. 1—THE CALLES DAM, MEXICO
Main dam on the Calles irrigation project.

More than half of the population of Mexico lives in the central plateau, occupying somewhat more than one-third of the area of the republic, one reason for this being the suitability of its temperate climate. But the density of population, cities and towns included, hardly reaches an average of 30 inhabitants to the square mile, whereas when the urban population is excluded the density drops to an average of seventeen. That the development of a region settled 400 years ago has been greatly retarded is evident. Perhaps no single physical cause has contributed more to this than the scantiness and irregularity of rainfall, while the sparsity of forests and meagerness of other forms of vegetation, in conjunction with the steep slopes of the general topography, result in untold waste of water by rapid runoff and evaporation. Under such conditions, agriculture is a precarious undertaking.

To remedy these conditions the aborigines from time beyond record resorted to irrigation, but their primitive efforts were confined to small diversions of water. During the colonial period and since the country gained independence a more advanced step was taken by resorting to storage, but these endeavors were on a small scale and were fundamentally deficient because they treated each case as an isolated local need and failed to relate the local problems to an entire hydrographic system. During the present decade the Water Board, under the Department of Agriculture, realizing that the lack of correlation in the developments was detrimental to a rational and efficient solution, divided the country into a number of natural watersheds in order to attain unity of purpose and conception in planning for the future.

In January, 1926, a law was enacted creating and providing for the operation of a National Irrigation Commission, with functions similar to those of the United States Reclamation Service. A large number of projects that had been studied in their preliminary stages and a mass of information that had accumulated in the Department of Agriculture were turned over to the commission. A few of the projects were selected for immediate execution, on account of ready feasibility or some pressing local need. Engineering parties and experts were sent to the field for the completion of the surveys, and by May of 1926 the plans for four developments were ready for action. These are the Mezquital, the Calles, the Nueva España and the Mante systems, all of which are now approaching completion. In Fig. 1 is shown the main dam of the Calles project on the Rio Santiago, 217 ft. high. Fig. 2 shows the multiple-arch dam at the head of the main canal on this same project. The latter dam is 142.3 ft. high.

During the progress on these projects others have been investigated. The accompanying table lists the principal systems in construction or under consideration, with their main features. In addition to the projects under the Irrigation Commission there are others subject to state

IRRIGATION PROJECTS IN MEXICO

| No. | Development: Name | Development: River | Dam and Reservoir: Type | Crown Lgth., Ft. | Height, Ft. | Storage, Acre-Ft. | Main Canals: Lgth., Miles | Main Canals: Cap., Sec.-Ft. | Land, Acres | Power, Hp. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Mesquital | Tepeji | Masonry | | 102 | 56,800 | 39 | 177 | 74,600 | ..... | Operating |
| 2 | Guatimapé | Guatimapé | Earth | 7,864 | 48 | 248,000 | | | 89,000 | ..... | Suppl. to old proj. |
| 3 | Calles | Santiago | Concrete arch | 985 | 217 | 284,000 | 18 | 470 | 87,000 | 15,000 | Near completion |
| 4 | Nueva España | Salado | Earth and concrete | 4,049 | 105 | 1,136,000 | 33 | 2,225 | 160,000 | 10,000 | Near completion |
| 5 | Mante | Mante | No storage | | | | 28 | 400 | 25,000 | ..... | Near completion |
| 6 | Corrales | Lerma | Concrete | 919 | 89 | 1,600,000 | Not determined | | 395,000 | 50,000 | Under consideration |
| 7 | Sauceda | Sauceda | Concrete | 427 | 98 | 130,000 | Not determined | | 42,000 | ..... | Under consideration |
| 8 | Villalba | San Pedro | Concrete | Not determined | | 735,000 | Not determined | | 42,000 | 20,000 | Under consideration |
| 9 | S. Buenaventura | Sta. Maria | Masonry | Not determined | | 485,000 | Not determined | | 148,000 | 25,000 | Under consideration |
| 10 | Tepuxtepec | Lerma | Masonry | 1,640 | 148 | 406,000 | Not determined | | 148,000 | 90,000 | In construction |
| 11 | Majlo | Lerma | Canal system for the above | | | | 37 | 424 | 74,000 | ..... | Under consideration |
| 12 | Cuitzeo | Grande | River training and drainage | | | | Not determined | | | ..... | Under consideration |
| 13 | Chapala | Chapala | Dyke system and drainage | | | | Not determined | | 222,000 | ..... | Under consideration |
| 14 | Yaqui | Yaqui | Projects not complete. | | | | | | 988,000 | ..... | Under consideration |
| Totals | | | | | | 5,080,800 | | | 2,074,000 | 210,000 | |

or territorial governments, some of which are now in execution, including a large development in Lower California.

*Nueva España Project*—A typical example is the Nueva España system, formerly called the Don Martin project. This development, located about 60 miles west of Laredo, on the international border, may be characterized as a typical semi-desert scheme, depending principally on impounding all the floodwaters coming down

FIG. 2—MULTIPLE-ARCH DAM, MEXICO
Diversion dam on the Calles irrigation project.

to the confluence of the two streams that form the Salado River, as shown in Fig. 3. These waters are impounded in a reservoir of 1,136,000 acre-ft. capacity covering about 50,000 acres in the valley of the Salado River and extending back into those of its affluents. Its axial dimensions are about 5x6 miles, and the average depth is 22 ft. Storage is accomplished by an earth dam with a concrete overflow extension or spillway and having as a complement an earth dike. Water is led either to a smaller regulating reservoir or directly into distributary canals providing irrigation for 160,000 acres. The reservoir site is underlain by alternating strata of limestone and shale, making it suitable in regard to imperviousness.

The Salado River originates at the confluence of the Nadadores and Sabinas rivers, which in turn receive the flow from an extensive tributary system of streams in a drainage area of about 11,500 square miles, an area almost as large as Maryland or more approximately of the same size as Belgium. The flow is subject to enormous seasonal and cyclic variations, caused by the irregularity of rainfall, which varies from less than 8 in. to somewhat more than 16 in. per year. The useful precipitation occurs in the form of showers and downpours from June to September. The records for the periods from 1901 to 1912 and from 1921 to 1928 give an average yield of 665,000 acre-ft. per year, but maxima exceeding 1,000,000 acre-ft. per year are recorded in four instances.

*Earth Dam*—The main dam is located at a gap in the low range of hills cut by the river and was complemented by a dike to prevent overflow over some saddles in the surrounding hills. The dam, of earth and gravel, is 3,484 ft. long, with a maximum height of 105 ft. One end abuts against the hill, and the other is joined to a concrete overflow extension. In section it has a 20-ft. crown, with slopes 1 on 1.75 for the upstream side and 1 on 2 for the downstream side, making the width of base at the deepest point about 414 ft. The dike is more than 6 miles in length, and reaches a height of 32 ft. Its sectional proportions are identical with those of the dam.

In both cases the material is a graded mixture of earth and gravel, proportioned 1 part fines to 2 parts gravel, which when compacted weighs 135 lb. per cubic foot. After the material was sprinkled it was spread in 8-in. layers by crawler tractors and compacted by 12-ton rollers. Excavation was done by 2½-yd. steam shovels serving dump cars hauled by 20-ton oil-burning locomotives. Both structures are lined on the water side, the revetment extending into bedrock for anchorage and rising 13 ft. above water level. For the dam, this revetment is a monolithic concrete slab, varying in thickness

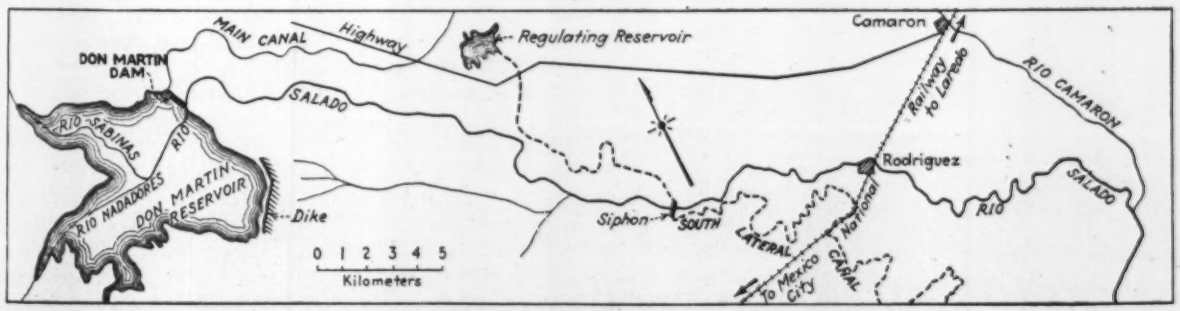



FIG. 3—NUEVA ESPAÑA IRRIGATION PROJECT IN MEXICO

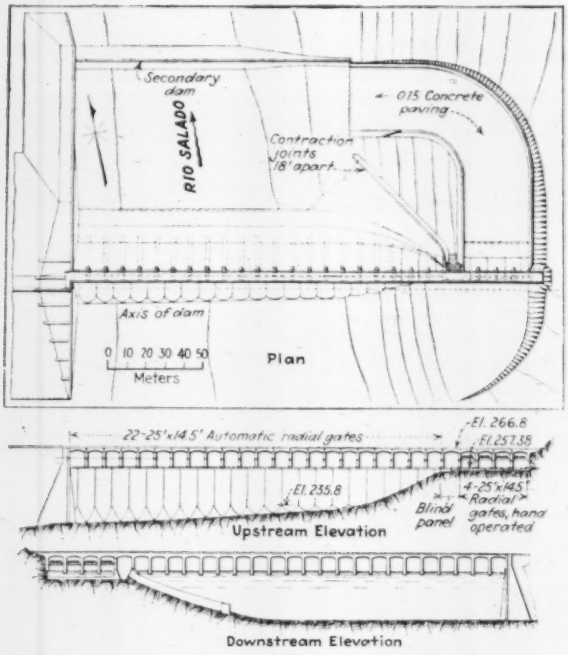



FIG. 4—SPILLWAY IN DON MARTIN DAM

from 11 in. at the bottom to 8 in. at the top, reinforced with ¾-in. rods spaced 18 in. apart both ways. The dike has 10 in. of lime-mortar masonry.

*Spillway*—The concrete overflow extension is joined to the earth dam by means of a deeply dented concrete cutoff wall. It is 565 ft. long and 82.5 ft. high at the deepest point. This portion presents a rather novel design, shown in Figs. 4 and 5, being composed of a series of 26 adjoining inclined buttresses, which structurally act as independent units. In horizontal section each buttress presents to the water a curved face, which receives the pressure for its transmission through an elongated thinner web or stem down to the supporting foundation. [It will be noted that the curved faces, as in Fig. 6, are not arches, but are the bulbous heads of the buttresses. EDITOR.]

Each head is 29 ft. wide and joins the adjacent one by a contact plane 6.5 ft. wide, provided with a copper strip embedded along the center line. The webs are 6.5 ft. thick, and have their fronts curving vertically to provide the supports for the 30-in. concrete apron which carries the overflow. This type of dam proved more economical than either a gravity section or a multiple-arch structure, and it affords greater security for the structure.

A series of 26 gates, of which 22 are of the automatic radial type and four designed for mechanical lift, is carried by piers in the crest of the spillway. Their operation depends on the action of floats and counterweights, so designed that when the water reaches a given elevation the gates start and continue to open to allow the passage of the overflow. The reverse action takes place on the receding of the water level. At full opening and with water 21 ft. deep on the crest, the discharge will be about 210,000 sec.-ft. To provide a cushion for the formation of a suitable hydraulic jump, an auxiliary concrete dam 23 ft. high will be built 400 ft. below the spillway, as shown in Fig. 4.

*Outlet Works*—The outlet works consist of two sets of rectangular gates, 3½x10 ft. Each set is composed of four regulating units and four emergency gates to be operated by internal combustion engines. The gates open into a double conduit, with elliptical sections 17½ ft. wide and 16½ ft. high, discharging into the diversion canal.

This canal, 18.6 miles long, has been designed to carry 2,225 sec.-ft. It has a bottom width of 60 ft. with side slopes of 1 on 1½ and a grade of 1 in 10,000. At full capacity the water will be 10.6 ft. deep and the mean velocity is figured at 2.78 ft. per second. The embankments have a crown width of 16 to 20 ft. and the minimum freeboard allowed is 3.25 ft. The diversion canal leads to an auxiliary reservoir of 1,200 acre-ft. capacity, provided for the conservation of water which otherwise would be wasted on the suspension of demand occasioned by sudden changes of the weather. The main canal, however, connects directly with the main lateral which serves the northern portion of the lands.

*Miscellaneous*—Difficult material has been encountered in excavation, ranging from compact clays to shales and conglomerates. It has required the use of explosives in considerable quantities and the employment of fifteen electric dragline excavators working sixteen hours a day. The lands reclaimed, which are of excellent quality for farming, are divided into two main portions: 74,000 acres north of the river and 86,000 acres on the south side. The mean water supply of 665,000 acre-ft. will permit a duty of 2.5 ft. at the farms, after allowing a 40 per cent loss. Open ditches, 8 to 10 ft. in depth, are provided for the drainage of stormwater and for the excess seepage that is expected to occur. There are numerous secondary structures, as well as a network of roads.

*Cost*—The cost of the development has been so far in the neighborhood of $10,000,000 (Mexican currency), and it is estimated that the final cost will be around $12,000,000. Taking two pesos to the dollar, the unit cost per acre will be about $37.50, U. S. currency. Altogether, the Irrigation Commission has spent nearly $30,000,000 (Mexican currency) in the execution of the projects now under way, and in the investigations and preparation of plans for other projects.

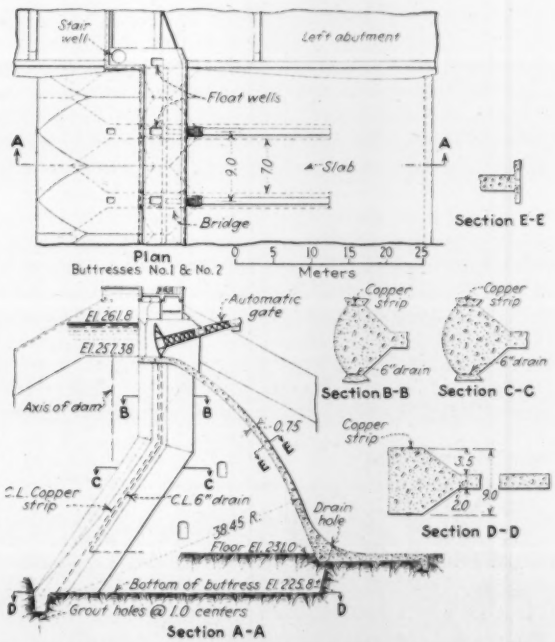



FIG. 5—DETAILS OF SPILLWAY
Note the bulb-headed buttresses which form the dam.

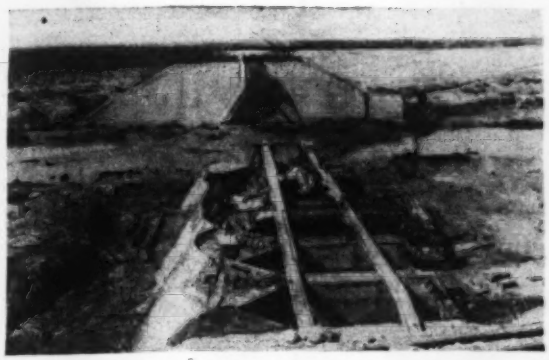


FIG. 6—BUILDING THE SPILLWAY
Beyond the farther abutment extends the earth dam.

Great credit is deserved by the National Irrigation Commission for the success of its accomplishments in governing the policies and directing the works. The members in office last year were F. A. Salido, J. Mares and J. Sanchez Mejorada, now secretary of Communications and Public Works. The design and execution of the Nueva España and other projects devolved upon the J. G. White Engineering Corporation (Mexican branch), under the management of G. W. Calwell. F. H. Weymouth was chief engineer, and C. H. Howell designed the concrete overflow dam. The construction operations were in charge of R. H. Connor. The Irrigation Commission was represented in the field by J. Oropeza as chief supervisor.

## Non-Pressure Creosoting Process Gives Good Results

### Sapwood Penetrated Completely in 4 to 36 Hours, According to Conditions—Hot and Cold Treatment

AN OPEN-TANK or non-pressure creosoting treatment for timber preservation which can give full sapwood penetration is in successful use and was described at the recent annual meeting of the American Wood Preservers Association by T. A. Wilson, superintendent of the timber department of the Consolidated Gas, Electric Light & Power Company, of Baltimore, Md. The author pointed out that careful study of temperature and time is necessary to secure such penetration regardless of the moisture content of the wood. It requires 4 to 36 hours of treatment, depending on the species, dimensions, moisture and amount of sapwood of the timber. Thus the process differs materially from the simple dipping process, which consists usually of submersion in hot creosote for five to fifteen minutes. For the non-pressure plant, the equipment consists of a 20,000-gal. cold-storage tank, a 7,500-gal. hot-storage tank, two open-top treating tanks 7x14 ft. and 10 ft. deep for butt-treatment of poles, and a tank 4x5½ ft. and 41 ft. long for lumber and timbers. This last tank has a removable cover. A motor-driven derrick handles material at the tanks and a gasoline crawler crane performs the yard work.

The hot-storage tank and the treating tanks are not heated by steam coils, as is customary. Steam is supplied to a circulating heater, and the preservative is pumped through this heater from and to the hot-storage tank and each of the treating tanks, as required. By this means the temperature of the preservative may be raised 1 deg. per minute in the hot-storage tank; and at the same time the preservative is kept thoroughly agitated. The circulating heater may also be used as a cooler, by the substitution of water for steam, to reduce the temperature of the preservative for the cool treatment without exposing the material to the air.

It has been found that the most desirable hot temperature for butt-treating chestnut poles is 230 deg. F., whereas chestnut ties cannot be successfully treated above 220 deg. on account of excessive checking. Round timbers can be treated at higher temperatures than when sawed, regardless of species. Thus round pine may be treated fresh from the stump by boiling in oil at 240 deg. F. for fifteen hours without apparent injury to the wood fibers, whereas longleaf pine crossarms seem to receive the best treatment without injury at 220 deg. and Douglas fir crossarms show evidence of splitting if a temperature above 215 deg. is used.

A comparatively wide range between temperatures of hot and cool baths is important, although without some artificial means of cooling the preservative for the latter it is frequently difficult to secure the desired variation. The most desirable temperature for the cool bath is about 125 deg. F., which gives approximately 100 deg. variation between the hot and cool baths. With lower temperatures there is usually an undesirable amount of preservative left on the surface of the wood and apparently the absorption is not so great. With higher temperatures the absorption is retarded.

The greatest volume of absorption appears to take place during the first hour of the cool treatment. However, in order to secure the maximum penetration and absorption the cool bath should last not less than half as long as the hot bath immediately preceding it, the actual time to be regulated according to the species, dimensions and sapwood content of the lumber. By using the circulating heater converted into a cooler, as noted, it is possible to reduce the temperature of the hot bath to that desired for the cool bath at the rate of approximately one degree per minute. The creosote in the treating tank is maintained at a uniform level and the timbers are not exposed to the air during the change of temperature. Evaporation loss from the large tank averages 25 lb. of creosote per hour when operating at 220 deg. F. Without a cover, the loss would probably amount to about 95 lb. per hour.

In specifications for non-pressure treatment of sawed lumber, Mr. Wilson suggests that it will probably be advisable to stipulate maximum and minimum temperatures, as well as minimum length of treatment for both the hot and cool baths. The periods of the baths would be extended in proportion to increased moisture content and dimensions of the lumber. He points out that the efficacy of this process is largely dependent upon plant equipment and upon the desire and ability of the operators to get the best results.

### Highway Progress in Alabama

State highway projects in Alabama completed in the fiscal year ended Oct. 1, 1928, comprised 288.17 miles of road, costing $3,840,938. In the same period 6,391 linear feet of bridges were constructed, at a cost of $694,157. Under construction on Oct. 1 were 954.57 miles of road, to cost $7,010,284, and 36,282 ft. of bridges, to cost $1,914,357.

# The Airport at Rome

## Unusual Two-Story Hangar Among the Several Buildings — Airport Conceived as a Recreation Center for the City

LITTORIA airport, a private enterprise, located about 4 miles northeast of Rome, is a good example of European practice in airport building. In addition, it is unique in that one of its main functions is to provide a recreation center for the citizens of Rome, at the same time bringing them into proximity with airport and airway matters. The Littoria airport was described by

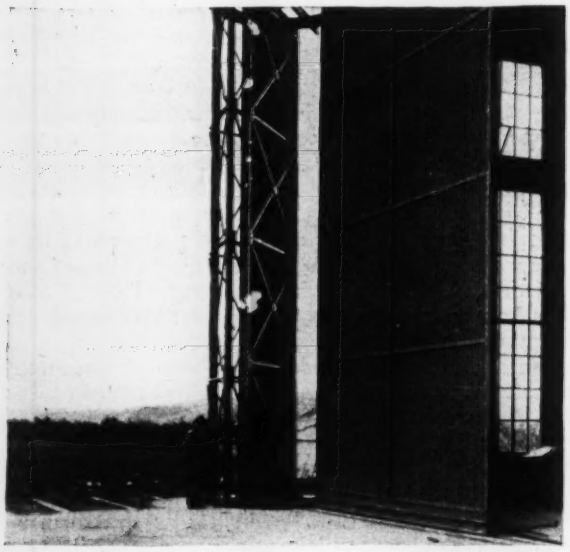


FIG. 1—OPENING HANGAR DOORS, LITTORIA AIRPORT

Cesare Valle in the Italian magazine *L'Ingegnere* for June, 1928. The following information is abstracted from that article.

The project was promoted in 1925 by the National Aeronautic Company and was built in 1927 under an agreement with the Italian government whereby the government lends specified financial support for the

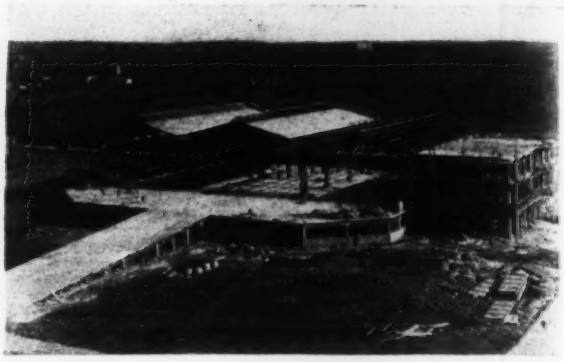


FIG. 3—CONSTRUCTING A TWO-STORY AIRPLANE HANGAR
Building at the right is a structure for airplane manufacturing purposes.

privilege of using a portion of the hangar and flying field for the training of government fliers. The airport is located in a bend of the Tiber River and covers about 1 square mile, bounded on the landward side by the Via Salaria. The useful length of the field in all directions is not less than 1,000 m. The width of the river at the airport is about 100 m. The land, which was originally farm land and almost perfectly level, was acquired by condemnation. Necessary construction work to fit it for an aviation field included grading, rolling, seeding and the installation of a drainage system.

Besides the hangar, which is a unique two-story rein-

FIG. 4—INTERIOR OF HANGAR BUILDING, LITTORIA AIRPORT

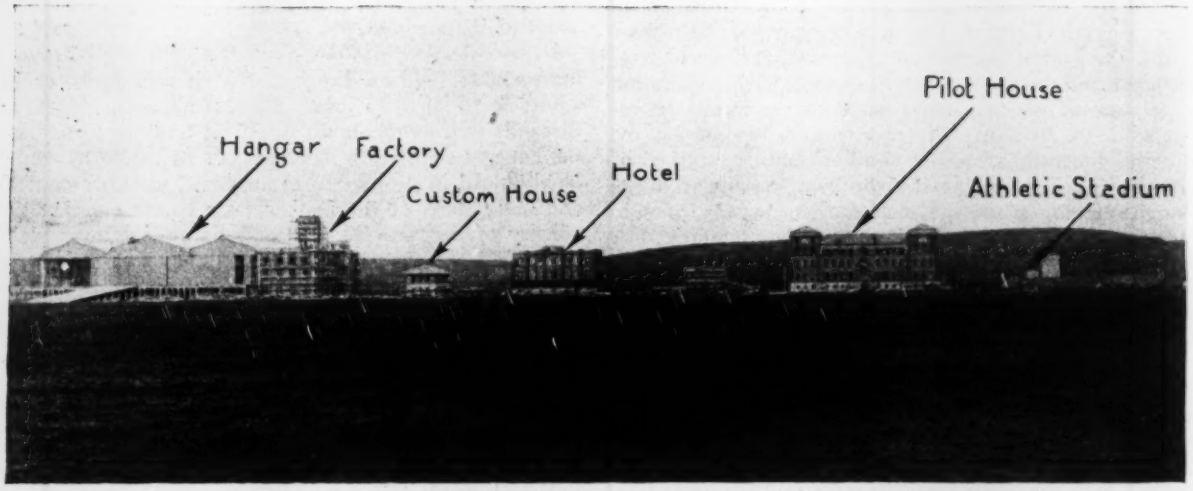



FIG. 2—THE VARIOUS STRUCTURES AT LITTORIA AIRPORT, ROME, ITALY

forced-concrete building capable of housing 150 planes, there are included among the structures at the airport a three-story factory building surmounted by an observation and wind cone tower, a small hotel, an office building, a clubhouse for aviators and an atheletic stadium. A number of the structures are shown in Fig. 2.

The hangar, as shown in one of the accompanying illustrations, is a two-story structure. The lower story is intended for the inspection planes of the National Aeronautic Company and has four bays. The upper story, for traffic planes, has three large and two small bays. The plan dimensions of the hangar are 100x50 m. The structure is of reinforced concrete, with concrete floors and a steel truss roof. Rolling steel doors of the type shown in Fig. 1 are provided at the front of each bay. At the ends of the front wall a rotary platform receives the door sections and swings them into the plane of the sides of the hangar building. The platform at the second floor is connected with ground level by an incline of 10 per cent.

In addition to these facilities an extensive gasoline-supply system is provided. Gasoline for the planes is piped from a central reservoir along the railroad, to pumps situated around the exterior of the field. The total storage capacity is 200,000 liters.

# Contraction-Joint Treatment in the Pardee Dam

## Vertical Planes Designed to Permit Shrinkage Without Leakage Spaced 150 Ft. Apart at Base, 37½ Ft. Near Top

By F. W. Hanna

*Designing and Hydraulic Engineer, East Bay Municipal Utility District*

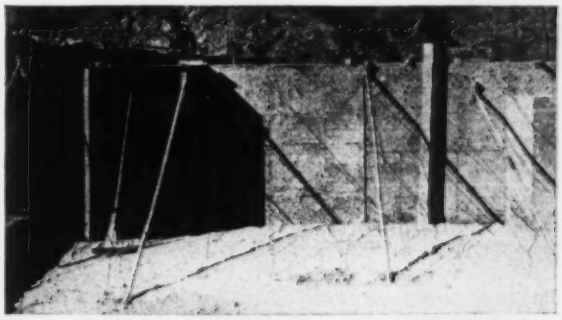
IN THE design of the Pardee dam, which is part of the Mokelumne River project now being developed to bring a new water supply to cities on the east side of San Francisco Bay, contraction joints to take up shrinkage due to setting of concrete and to temperature changes are spaced at varying distances. A wider spacing is used in the thick concrete at the base, and closer spacing as the section thins toward the top. Careful provision is made for a thorough grouting of the joints. The grouting is to be done in the cold-weather season next following completion of the dam. A general description of the construction methods on Pardee dam appeared in *Engineering News-Record*, Feb. 14, 1929, p. 258.

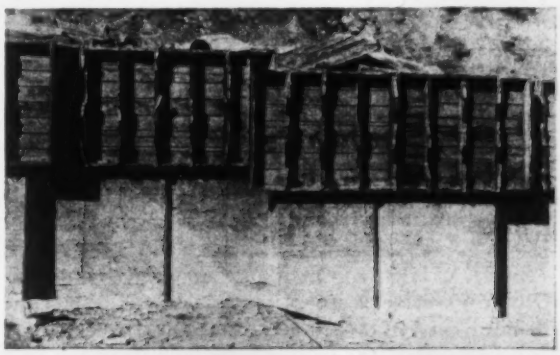
The height of the dam from lowest concrete to top of parapet is 359 ft. Up to a height of 179 ft., contraction joints are spaced at 150-ft. intervals; from here to a height of 279 ft. above the bottom a 75-ft. spacing is used, while from this level to the top the spacing is 37½ ft. These spacings are measured along the arc of the downstream edge. The joints are in radial planes.

For the purpose of making a more tortuous passage for water through the dam at the joints and providing ample shearing area, each contraction joint is recessed to the depth of 1 ft. and a width of 10 ft. at intervals of 10 ft. across the face of the contraction joint. It will be noted from the drawing that the recesses stop short of the downstream face of the dam, so that the visible contraction seam on the downstream face of the dam appears as a straight line.

There is a copper water-stop across the contraction joint 18 in. from the upstream face of the dam, to prevent entrance of water. Also, a galvanized-iron grout-stop is placed just downstream from the drainage wells near the upstream face, and another is placed near the downstream face of the dam, for the purpose of retaining grout under pressure within the contraction joint. A similar grout-stop passes around the inspection gallery.

Vertically in the center of each recess and of each intervening section of the normal face of the contraction joint there is a grout hole extending up from the base of the dam to the downstream grout plate, thence at right angles thereto to the downstream face of the dam. Within the confining limits of the grout plates the cross-section of the grout hole consists of a combined trian-



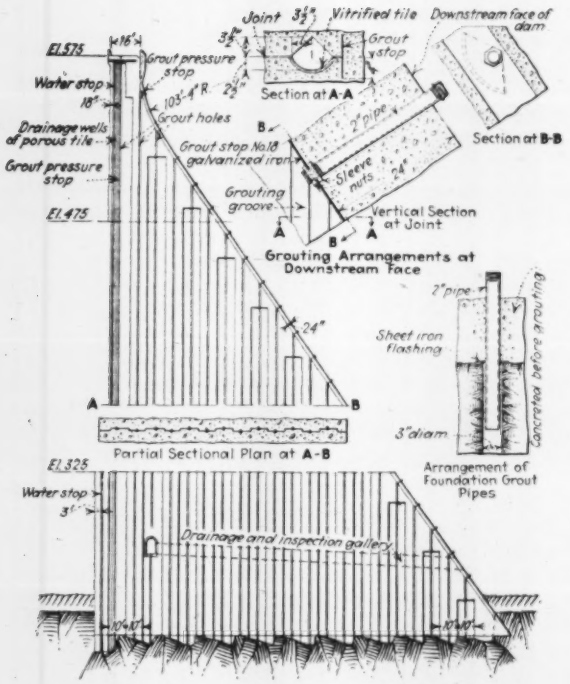


CONTRACTION-JOINT FORMS AND FINISHED SECTION FACE

At top—Concrete forms ready for pouring. These forms are metal faced wood panels on a radial joint. Note vertical V-troughs to form grout grooves.

In middle—Face of radial joint after stripping. Note V-trough in center of each 10-ft. face. Adjacent faces offset 1 ft.

At bottom—Face of radial joint with tile placed over groove. Segments of vitrified tile are wired over the grooves before abutting concrete block is poured.




TYPICAL JOINT SECTION OF PARDEE DAM SHOWING DETAILS OF GROUTING SYSTEM

gular and circular segment; and outside of the downstream grout plate the hole is a 2-in. pipe extending to the face of the dam. Tightness between pipe and grout plate is secured by means of a sleeve nut on each side of the plate screwed tightly against it. The outer end of the pipe is threaded to provide for attaching the grouting machine.

The grout holes in the body of the dam within the boundary of the grout plates are formed on the advance face of the contraction joints by means of right-angle troughs made of 1x4- and 1x5-in. boards nailed together at one edge and beveled at the other. These troughs are nailed to the forms, thus producing triangular notches 7 in. wide adjacent to the forms. When the forms are removed from the advance faces and prior to building the adjacent faces of the contraction joints, segmental tiles of 7-in. chord and 2½-in. rise are placed over the triangular notches and held in position by wires previously embedded in the advance faces. (See the accompanying views.)

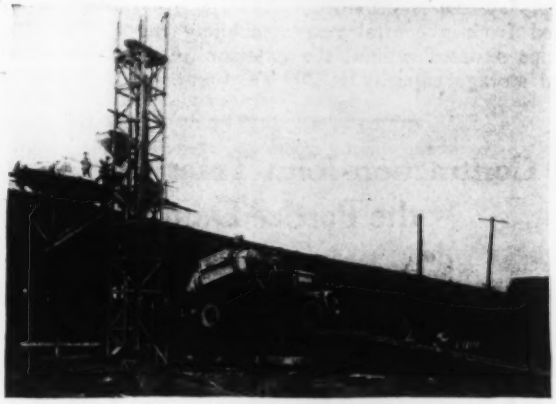
It is estimated that 110 cu.yd. of grout will be required to fill the grout holes at the contraction joints, and about 140 cu.yd. additional to fill the joints, making a total of about 250 cu.yd. The grout will be placed by pressure from the start, using pressures of 100 lb. per sq.in. or more.

The dam will be completed during the early part of the summer of 1929, and it is proposed to do the grouting of the contraction joints during the following winter, 1929-30. This will give ample time for radiation of the setting temperature and for contraction of the concrete due to the lowered temperature of the season, since the bottom or thicker part of the dam will then have been poured for considerably over a year and the upper or thinner part for several months.

In conclusion, attention is directed to the fact that the Pardee dam is a curved gravity dam (full gravity section). The contraction joints and the accompanying grouting system are being provided not only to prevent cracking of the masonry and leakage but also to insure as much arch action as possible for the purpose of increasing the factor of safety.

## Concrete for Bridge Ramp Delivered by Mixer Trucks

IN THE construction of the Lovejoy St. ramp of the Broadway bridge at Portland, Ore., a total of about 10,000 cu.yd. of concrete was required for placement in an area where it was practically impossible to occupy any considerable amount of space with construction equipment or materials stock piles. The entire work, therefore, says G. B. Herington, executive secretary, Portland Chapter, Associated General Contractors, was supplied with concrete by mixer trucks which delivered ready-mixed concrete at the time and place required without the necessity for any temporary structures that would block the railroad tracks passing beneath the ramp.



MIXER DISCHARGING CONCRETE FOR BRIDGE RAMP
This was one of several delivery points located to simplify concrete placing.

In planning this work the construction plant was laid out for the delivery of concrete at several points. Two concreting towers were erected in the usual way, delivering to small buggy-loading bins at the top, and at the bottom equipped with 5-cu.yd. bins from which to feed the hoist buckets. Truck mixers discharged into the 5-yd. bins from platforms elevated a few feet above the ground and reached by short ramps. The truck mixers used had a capacity of 2½ to 3½ cu.yd. and a total of seven were used in the fleet which supplied this job.

The bridge ramp was built under the general direction of O. Laurgaard, city engineer, by Lindstrom & Feigenson, contractors.

## Huge Block of Granite Quarried

A block of granite which may be a record for size has recently been freed in the quarry of the John L. Goss Corporation, Stonington, Me. It is 200 ft. long, 75 ft. wide and 40 ft. high, making 600,000 cu.ft., and weighs about 50,000 tons. Needless to say, it will not remain long in one piece, but will be split up into sizes more convenient to handle.

# Welding— A New Tool for the Structural Fabricator

## Present State of the Art, Particularly the Arc Process, as It Has Been Developed Over the Past Two and a Half Years

By Fred T. Llewellyn

*United States Steel Corporation, and President, American Welding Society*

SHORTLY before the formation of the structural steel welding committee which now functions under the American Bureau of Welding, a board of research sponsored by the National Research Council and the American Welding Society, J. H. Edwards, who has since become chairman of the committee, outlined several questions satisfactory answers to which he thought must precede any general acceptance of fusion welding as a major tool by the structural industry. Since the formulation of these questions considerable progress has been made in the art of welding, and it is the purpose

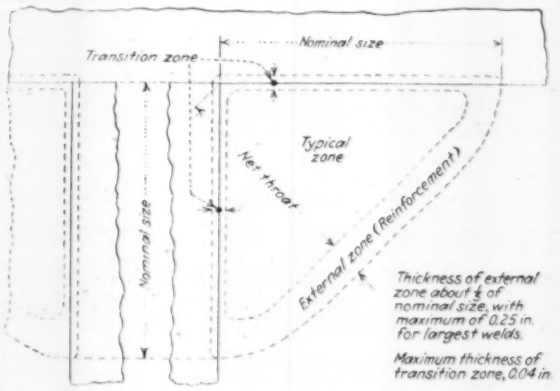

Transition zone
Nominal size
Typical zone
Net throat
Nominal size
External zone (Reinforcement)
Thickness of external zone about ¼ of nominal size, with maximum of 0.25 in. for largest welds.
Maximum thickness of transition zone, 0.04 in.

FIG. 1—DIAGRAMMATIC SECTION THROUGH FILLET WELD SHOWING THREE ZONES OF WELD METAL

of this article to indicate to what extent these questions are now capable of being answered.

The facts presented refer primarily to direct-current, metal-arc welding, which has been developed to a greater extent than any of the other processes in the structural field. Many of our present data have been derived from the activities of the structural steel welding committee, although its final report has not yet been made. The replies attempted to the question here are largely the personal observations of the author, which may be qualified when this final report is made. Also in supporting some of them the studies by H. Dustin, of the University of Brussels, whose experience is in general agreement with that of investigators in this country, will be utilized. The questions and the comments thereon will be taken up in order.

1. *Can standard grades of steel be satisfactorily welded?*

The weldability of standard grades—that is, those commonly used for bridges and buildings—is established by thousands of tests and numerous welded structures in many sections of the country. Silicon steel also seems to be well suited to welding and high-carbon steel and special alloys have been satisfactorily welded, but these products have not been investigated sufficiently to warrant an unqualified statement regarding their behavior when welded.

Grades of welding wire are probably more important than grades of base metal steel, and therefore mere economy in first cost is a mistaken basis on which to judge welding wire. The conclusions presented in this paper are predicated on the use of bare wire of a grade equal to class E1A (maximum carbon 0.06) or E1B (carbon 0.13 to 0.18) of the American Welding Society, as applied to mild steel base metal (maximum carbon 0.30) conforming to A.S.T.M. specifications A-7 or A-9. "Bare" wire actually is coated with a lubricant of lime or some other alkali which is necessary in the wire-drawing process and incidentally is absolutely necessary in the welding process to furnish the slagging flux essential to the soundness of the deposited weld metal. "Coated" wire, on the other hand, refers to wire that has received a specially applied fluxing coat (generally a silicate) of considerable amount. "Covered" wire is

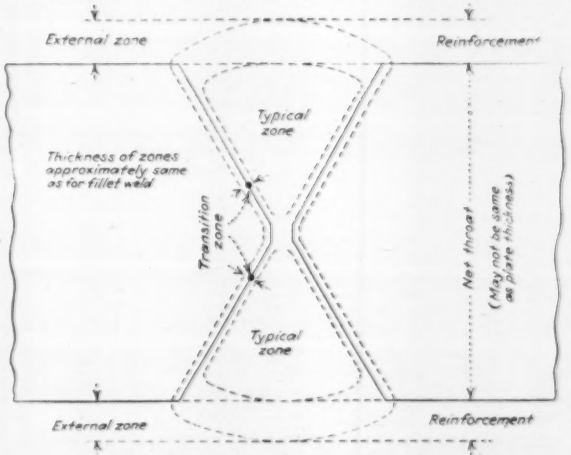



FIG. 2—DIAGRAMMATIC SECTION THROUGH DOUBLE VEE BUTT WELD SHOWING THREE ZONES OF WELD METAL

enveloped by a fabric (frequently of asbestos) which either serves to retain the coating between it and the wire metal core or which has itself been impregnated with a suitable flux. According to Dustin a coating has three functions: (*a*) to combine with the oxides of the base metal; (*b*) to protect the molten metal with a deoxidizing slag; and (*c*) to serve as the vehicle for the introduction into the weld of special elements (carbon, nickel, manganese, chrome, etc.) in case it is desired to modify properties.

2. *What effect will the welding operation have on the base metals that are to be united?*

The answer is that it will have no harmful effect,

*Abstract of a paper given before the annual convention of the American Institute of Steel Construction at Biloxi, Miss., Nov. 14.*

certainly not if the base metal is mild steel. A weld may be considered to be divided into three zones, a transition zone at the contact surface of weld and base metal, a zone in the body of the weld and an external zone. (See Figs. 1, 2 and 3.) The transition zone never attains a thickness of 1 mm. and only from 0.2 to 0.3 of its thickness is occupied by the portion in which there is interpenetration of base and weld metal. Micrographs sometimes show more slag inclusions in this portion of the weld than in others, which means that the metal in this zone is not always as strong per unit as that in the body of the weld, a weakness which in current practice is compensated for by providing contact surfaces that are greater than the critical throat dimensions. In the case of important butt welds additional area is secured by beveling the edges of the base metal, thereby giving to the weld a V form. In the case of triangular fillet welds no such preparation is needed, for the reason that the ratio of the leg of an isosceles right triangle to its hypotenuse is happily greater than is required. This is one reason why a fillet form of weld is to be preferred in most structural work. It eliminates the cost of beveling.

The thermal effect of the welding operation has sometimes been thought to cause brittleness in the base metal near the weld. Some of Dustin's experiments indicated the contrary—namely, that the effect of welding was to reduce the ultimate strength of the adjacent base metal by 20 per cent, accompanied, however, by an increase in ductility. (See Table I.) During welding the base metal is raised to a bright red color over a belt whose width varies with its thickness and with the volume of the weld. Since this cools freely in the air, it means that near the weld the piece undergoes precisely the same treatment as would normalize mild steel. The reason why ruptures occur more often in the base metal than in the weld itself is that while ordinary weld metal has a somewhat lower ultimate strength than the base metal, it has a much higher yield point. Therefore, necking and consequent rupture are apt to start in a normalized part of the base metal rather than in the weld.

TABLE I—EFFECT OF WELD ON BASE METAL (DUSTIN)
Weld Metal T except for a coating corresponds to the better grades of wire used in this country for structural work

| | Averages of Three Specimens Machined to 0.79-In. Diam. | | | |
|---|---|---|---|---|
| | Unwelded | | | |
| Properties Tested | Untreated | Annealed Ten Minutes At 900° C. | Welded With T Metal | Neat Weld Metal, Deposited From Wire T |
| Ultimate tensile strength, in lb. per sq. in. | 67,200 | 50,700 | 53,400 | 56,700 |
| Per cent elongation measured on 7.9 in. for unwelded specimens, and on 3.9-in. for neat weld metal | 12.0 | 32.0 | .... | 16.8 |

FIG. 3—MACROGRAPH OF A ⅜-IN. SINGLE VEE BUTT WELD

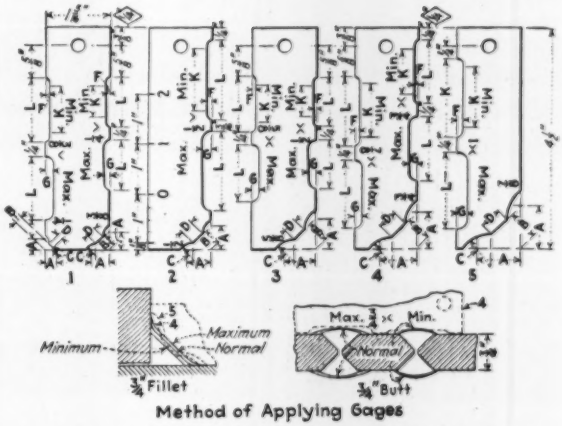



FIG. 4—GAGES FOR FILLET AND BUTT WELDS
The five gages shown can be applied to ¼-, ⅜-, ½-, ⅝-, ¾-, ⅞- and 1-in. butt welds and ¼-, ⅜-, ½-, ⅝-, ¾- and ⅞-in. fillet welds. The method of application is shown at the bottom of the illustration and the limiting dimensions are tabulated in Table II. These gages have been used for some years by the Newport News Shipbuilding & Drydock Company and are being employed by the structural steel welding committee in its program of tests.

3. *Can methods of making welds by different processes be standardized?*

Specifications covering the making of welds by the direct-current metal-arc process and by the oxyacetylene gas process have already been prepared by the structural steel welding committee, and its authoritative specifications covering methods will doubtless be available to the industry within the next year or two. Also, at the present time many shops are engaged in structural welding on a commercial basis, and already we are using ⅜-in. fillets as standard much the same as ¼-in. rivets are considered as standard.

4. *Can values be fixed on some unit basis for the strength of the more usual types of welded joint?*

Certainly such values can be fixed for quiescent static loads and probably for dynamic loads, although the latter require further investigation. Hundreds of tests under static loading have given results which agree with as much uniformity as do those on unfabricated steel and with more uniformity than many of the tests that have been made on steel fabricated by other methods.

In discussing the properties of welds it is necessary to distinguish between the strength of the neat deposited metal and the strength of the joint as a whole. Dustin reports a series of tests made at Brussels on deposited metal without reference to the members to be joined, using three different brands of welding wire. He does not state whether alternating or direct current was employed. The three types of wire, of mild steel containing 0.10 to 0.14 carbon, are designated by B, T and N. Wire B was of very high grade, but costly. It was electroplated with 1.25 per cent of nickel and carried a thick coating confined by a braided asbestos covering. It is not representative of American practice. Except for a heavy coating, wire T parallels the better grades of wire used in this country for structural work. Wire N was a cheap grade, corresponding apparently to material used here for minor repair work, except that it had a thin coating. The average ultimate tensile strength of 105 specimens of three sizes consisting of neat metal deposited by the three wires may be approximated at 70,000 lb. for metal B, 56,000 lb. for metal T and 48,000 lb. for metal

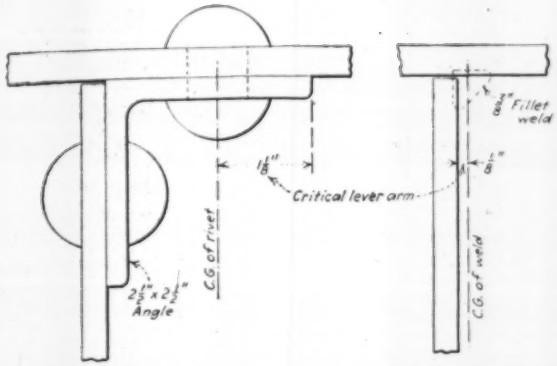



FIG. 5—COMPARISON OF LEVER ARMS OF ANGLE AND FILLET WELD SHOWING DANGER OF USING UNSYMMETRICAL WELDS

N. The uniformity of results for each metal was very satisfactory. Other tests indicated a modulus of elasticity in tension of 29,000,000 and in shear of 10,500,000 lb., which are substantially the values for mild steel. The tests also indicated average ultimate strength in shear of 48,000 lb. for metal B and 41,000 lb. for metal T, with corresponding yield points of 27,000 and 22,000 lb.

For butt welds the throat area (Fig. 2) in square inches is a suitable unit in which to express working values. In computing this area the writer recommends that any reinforcement be disregarded and that the base metal thickness be considered as net throat. For fillet welds (Fig. 1) the throat would also be a proper unit, but its use is less convenient than is that of the leg; as the mathematical ratio between them is constant, the latter is equally correct. In practice it seems advantageous to express fillet values in terms per linear inch for each size of weld.

TABLE II—DIMENSIONS FOR WELD GAGES (INCHES) (SEE FIG. 4)

Fillet Welds

| Nominal Size (A) | Throat Min. (B) | Throat Normal | Radius (C) | Dimension (D) | NOTE: (D) is symmetrical about 45° axis from corner of gage. At no point shall weld fall below triangle of its nominal size, nor exceed triangle of nominal size ⅛ in. greater. |
|---|---|---|---|---|---|
| ¼ | 0.177 | 0.221 | ⅛ | ¼ | |
| ⅜ | 0.265 | 0.309 | ⅛ | ⅜ | |
| ⅜ | 0.354 | 0.398 | ⅛ | ½ | |
| ½ | 0.442 | 0.486 | ¼ | ⅝ | |
| ½ | 0.530 | 0.574 | ¼ | ¾ | |
| ⅝ | 0.619 | 0.663 | ¼ | ⅞ | |

Butt Welds (Angle Between Bevels 75° to 90°)

| Nominal Size (E) Plate Thickness | Reinforcement for Single Vee (V) Min. (F) | Reinforcement for Single Vee (V) Max. (G) | Normal | Reinforcement for Double-Vee (V V) Each Side Min. (F) | Reinforcement for Double-Vee (V V) Each Side Max. (G) | Normal | Width Max. (L) Arc Welds Only Min. (K) | Width Max. (L) Arc Welds Only |
|---|---|---|---|---|---|---|---|---|
| ¼ | 0.063 | 0.125 | ⅛ | ..... | ..... | .. | ¼ | ½ |
| ⅜ | 0.063 | 0.156 | ⅛ | ..... | ..... | .. | ⅜ | ⅝ |
| ⅜ | 0.094 | 0.187 | ¼ | ..... | ..... | .. | ⅜ | ⅝ |
| ⅜ | ..... | ..... | .. | 0.050 | 0.150 | ⅛ | ⅜ | ½ |
| ½ | ..... | ..... | .. | 0.063 | 0.162 | ⅛ | ½ | ⅝ |
| ½ | ..... | ..... | .. | 0.075 | 0.175 | ¼ | ½ | ⅝ |
| ⅝ | ..... | ..... | .. | 0.088 | 0.187 | ¼ | ⅝ | ⅞ |
| 1 | ..... | ..... | .. | 0.100 | 0.200 | ¼ | ⅝ | ⅞ |

Allowable working unit values for fillet welds appear to be crystallizing at about 28 per cent of the ultimate strength under shear of the neat weld metal. Thus a value of 3,000 lb. per linear inch is in frequent use for the ⅜-in. fillet, and it looks as if a safe value for other usual sizes of fillet can be figured on the basis of 1,000 lb. per eighth of an inch of nominal size. For butt welds in tension, values around 15,000 lb. per sq.in. have been employed, but the writer is inclined to think that in the present state of the art a working value of not over 13,000 lb. per sq.in. is preferable. In many framed structures details can be arranged to eliminate all butt welds, and this seems desirable where possible.

Some distinction should be made between large and small welds. Other things being equal, the unit strength of a perfect small weld is measurably greater than that of a large one. On the other hand, this superiority in unit strength is counterbalanced by the larger proportional effect of a minor defect in a small weld.

The difference in unit values for welds aligned normal to the direction of stress and parallel to the direction of stress does not seem to be large enough to warrant different working values under static load. On the other hand, impact tests on welds aligned parallel to the direction of stress have shown higher and very much more regular values than have those at right angles.

In the design of welded structural joints the possibility of any considerable eccentric stress is to be avoided, and it is equally important to avoid non-symmetry in the details of each part, whether primary or secondary, during transportation or erection. For example, a fillet welded on one side of a minor joint has only one-ninth the lever arm that a single 2½-in. riveted angle would have, as shown in Fig. 5. Such a weld lever arm would offer no appreciable resistance to those prying actions that are apt to occur during handling. Therefore it is desirable to weld fillets on both sides of a member, making them short or intermittent if their duty so permits.

TABLE III—SOME WELDED BUILDINGS ERECTED 1927–1928

| Location | Owner | Description | Size (Ft.) Width | Size (Ft.) Length | Number of Stories | Approx. Steel Tonnage |
|---|---|---|---|---|---|---|
| Derry, Pa. | Westinghouse E. & M. Co. | Light Mfg. Bldg. | 164 | 460 | 1 | 350 |
| W. Philadelphia, Pa. | General Electric Co. | Mfg. Bldg. with Crane Runways | 138 | 552 | 2 | 1,000 |
| Pittsfield, Mass. | General Electric Co. | Mfg. Bldg. | 39 | 280 | 2 | 250 |
| | | | 21 | 280 | 1 | |
| Chicago, Ill. | Mississippi Valley S. S. Co. | Steel W'house with Crane Runways | 135 Clear | 340 | 1 | 400 |
| Emeryville, Calif. | Associated Oil Co. | Automotive Shop | 60 Clear | ... | 1 | 300 |
| Hot Springs, Va. | Homestead Hotel | Addition to Hotel | 72 | 136 | 6 | 550 |
| | | | 56 | 56 | 12 | |
| Atlantic City, N. J. | Chalfonte-Haddon Hall | Power House | 72 | 79 | 6 | 350 |
| N. Tonawanda, N. Y. | Tonawanda Power Co. | Office Bldg. | 74 | 140 | 4 | 200 |
| | | | 28 | 32 | 2 | |
| New Haven, Conn. | Yale University | Supports for Book Stacks | 150 | 220 | 18 | 800 |
| | | | | 150 Ft. | | |

5. *Is there some way of determining the reliability of the completed weld?*

This is doubtless the most important question to be

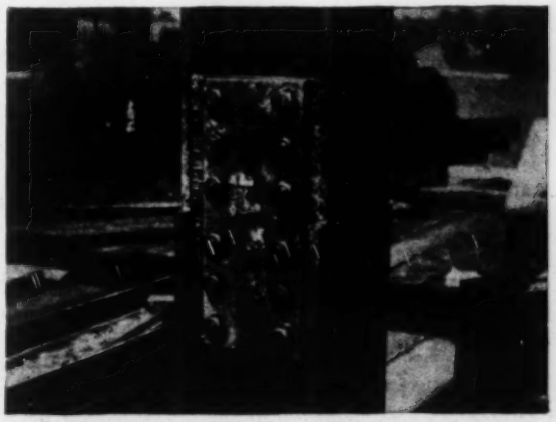


FIG. 6—COLUMN SPLICE, HOMESTEAD HOTEL, HOT SPRINGS, VA., SHOWING COMBINATION OF BOLTING AND WELDING

answered. A number of methods have been developed, such as visual inspection for shape and color, sound of the arc, X-ray examination and the electric conductivity test for potential drop. Automatic processes are also finding increased fields of application. All these things are good, but from a rigorous standpoint the writer believes that we can no more be certain that a specific portion of weld is sound, without destroying it, than we can tell whether a specific rivet fills the hole without destroying it. Confidence in rivets has been a thing of growth and has not resulted from the fact that an inspector's hammer reveals the poorly and well-driven rivets. Thirty-five years ago all structural specifications limited field rivets

TABLE IV—SOME WELDED BRIDGES ERECTED 1927–1928

| Location | Owner | Description | Spans—Number | Spans—Lgth. (Ft.) | Total Length (Ft.) | Approx. Steel Tonnage |
|---|---|---|---|---|---|---|
| Leavenworth, Kan. | C. & G. W. R.R. Co. | Reinforcement of Railroad Bridge | 3 | | 1,100 | 100 |
| Havre de Grace, Md. | State of Maryland | Double Decking of Highway Bridge | | 250 | 3,300 | 1,500 |
| Chicopee Falls, Mass. | Boston & Maine R.R. | Single-Track Railroad Bridge | 1 | 135 Skew | 170 | 100 |
| Bound Brook, N. J. | Public Serv. Corp. | Renewal of Highway Bridge | 2 | 85 | 170 | 50 |
| Memphis, Tenn. | Harahan Bridge | Widening of Roadway | ... | ... | ... | 250 |
| New York, N. Y. | Interboro R. T. Co. | Girders for Crane Runway | | | 1,800 | 150 |

to only two-thirds the value allowed for shop rivets. Today that classification has gone, and the distinction is between hand-driven and machine-driven rivets, in the latter of which we have acquired much confidence.

Confidence may be developed for welding in several ways: by familiarity occasioned by every structural shop doing some welding, if it be only on minor joints; by flame-cutting short sections of weld and examining their interior; by occasional non-destructive tests on portions of a completed structure; by a proper selection of welding wire; and, most important of all, by qualification of the welder.

6. *Can the welding operations be done at a competitive cost?*

On certain classes of work it can, and for other classes of work, costs so far available have been higher for welding than for older methods of fabrication. The higher costs appear to be reflected not so much in the expense of making the welds themselves as in the labor involved in preparation—for instance, in cutting rolled steel members to closer length tolerances than are established practice at the mills. Shop costs have been augmented by the fact that there has not been sufficient volume of structural welding to keep a shop continuously busy.

Experience so far has been somewhat as follows:

(*a*) Competitive costs can be secured on low beam-and-column buildings whose details are sufficiently simple to permit the rolled steel members to be shipped direct from the mill.

(*b*) Competitive costs can be secured on certain types of shop-welded structures in which considerable savings in weight are secured, notably in truss work in which the net section of tension members is important and where gusset plates and other expensive details can be largely eliminated. This type of work was exemplified by the General Electric Building in Philadelphia (*Engineering News-Record*, May 17, 1928, p. 766).

(*c*) Competitive costs are frequently obtainable on existing bridges and other structures which require reinforcement to meet added loadings. The saving here is largely due to the avoidance of the expensive hand drilling of holes in the field.

(*d*) Competitive costs may not be obtainable on the taller beam-and-column buildings whose details are so important as to require shop preparation, until such time as there is enough business of this character to occupy a shop continuously.

(*e*) Competitive costs can be secured on tall beam-and-column buildings, which embrace additions to buildings already occupied, where the elimination of noise during construction has real monetary value.

*Conclusion*—The writer does not consider that welding is necessarily a competitor to the older methods of fabrication, such as punching. He believes that in many structures the two processes can be suitably combined (Fig. 6) and would merely urge that welding be given ample opportunity to prove wherein its advantages lie as a major tool in the structural industry. The American Welding Society is endeavoring to compile authoritative welding specifications for use in city building codes. Until these are available it is recommended that the welding of structural framework be covered by special permit, with due attention to the responsibility and skill of the applicant.

# Present Status of the Boulder Canyon Project Outlined

IN VIEW of the many inquiries received each week as to when work on the Boulder Canyon project will start, the following bulletin issued by Dr. Elwood Mead, commissioner, Bureau of Reclamation, Washington, D. C., is reproduced, practically in full.

—EDITOR.

ON DEC. 21, 1928, the President approved the Boulder Canyon project act, which authorizes the construction by the Secretary of the Interior of the Boulder dam and incidental works on the Colorado River. The project includes:

1. The construction of the Boulder dam, in Black Canyon, where the Colorado River forms the boundary between the states of Arizona and Nevada. This construction will raise the present surface of the water 550 ft. The dam site is about 30 miles southeast of Las Vegas, Nev., a town with a present population of about 5,500, located on the Los Angeles & Salt Lake line of the Union Pacific System. The dam will create a reservoir with a capacity of about 26,000,000 acre-ft. of water. It will serve to impound the surplus floodwaters of the Colorado River for use in irrigation and will also regulate the flow of the river so as to improve navigation and protect the lands in the valleys adjacent to the river below the dam and in the Imperial Valley in California from overflow, water shortage and silt accumulation, which are at present a great menace to agriculture.

2. The development of 1,000,000 hp. hydro-electric energy at the dam, with 550,000 constant horsepower available at all times.

3. The construction of an All-American canal from Laguna dam, or other suitable diversion dam, to connect with the present irrigation distribution system in the Imperial Valley in California, a distance of about 75 miles, and an extension to the Coachella Valley, also in California. (Note: The Laguna dam is already constructed and is located in the Colorado River about 9 miles northeast of Yuma, Ariz.)

The act authorizes an appropriation of $165,000,000. It is expected that it will take seven years to complete the dam from the time construction is begun. It is proposed to install units of the power plant progressively as demand for power develops.

The temperature at the dam site varies from a mini-

mum of 20 deg. F. to a maximum of 120 deg. F. above zero.

All public lands in the immediate vicinity of the dam site have been withdrawn from entry for construction purposes. All public lands which will be irrigated under the Boulder Canyon project have been withdrawn from entry and will not be available for settlement until the dam is completed and water can be furnished for irrigation purposes.

*Act Not Yet Effective*—The Boulder Canyon project act does not appropriate any funds for the work; nor does the act become effective until several conditions shall have been met. Among these conditions are: ratification of the Colorado River compact by the seven basin states (Arizona, California, Colorado, Nevada, New Mexico, Utah and Wyoming) on or before June 21, 1929, or after six months by at least six of the seven states, one of which must be California, and issuance by the President of public proclamation thereof; agreement by the State of California that its annual consumptive use of Colorado River water shall not exceed 4,400,000 acre-ft. of the waters apportioned to the lower basin states by the Colorado River compact plus not more than one-half of any excess or surplus waters unapportioned by the compact; the securing of contracts sufficient to pay operation and maintenance costs and return the cost of construction, including interest, within a period of 50 years after the act becomes effective. It will be necessary for Congress to make the appropriations required to commence and carry on the work.

[Since this statement was prepared Utah has ratified the Colorado River compact; thus six of the seven states have now ratified the compact.—EDITOR.]

It will necessarily take a considerable period of time to meet these several conditions, and their fulfillment, together with the time necessary for technical studies, preparation of designs and specifications and the issuance of advertisements, will consume at least a year and probably longer before contracts can be let for the construction of the dam. It is necessary to emphasize this in order to correct the general impression which seems to prevail that a large construction force is to be organized at once.

*Construction Railroad*—As a preliminary to the dam construction it will be necessary to build a construction railroad about 30 miles long, to connect the main line at or near Las Vegas, Nev., with the dam site. It will also be necessary to provide electric power for use during the construction period.

*Contract Policy*—Following the present policy of the Department of the Interior, it is expected that all construction will be done by contract, but no decision has been reached in regard to this. If contracted, by far the larger number of men engaged on this work will be employed directly by the construction contractors, including practically all those in positions such as laborer, helper, cook, steward, skilled mechanic, storehouseman, timekeeper, costkeeper, truck driver, foreman, construction superintendent, etc.

If done by contract, the contractors, and not the United States, will purchase and furnish all construction equipment required on this work. Materials required, such as cement, lumber (except form lumber), reinforcing steel, etc., and permanent operating equipment such as pipe, outlet gates, valves, etc., will be purchased by the United States, but only after appropriate advertisement.

*Concessions*—It is too early to determine the policy that may be adopted in the matter of concessions at the dam site. On contract work the general contractor usually supervises, controls and operates the major concessions, especially those located in the construction camps, such as commissary, dormitories, mess houses, hospital, etc.

*Government Organization*—If the work is done by contract, a certain organization will be required by the United States to handle the inspection, engineering and supervision. All employments on the government rolls will be in strict accordance with the rules and regulations of the United States Civil Service Commission. To be eligible for appointment in the classified civil service, applicants must first qualify through appropriate competitive examinations.

Recent publications dealing with this proposed development and available on request are the report of the special advisers on the development of the Colorado River, the report of the Colorado River Board, and a reprint of an article by Chief Engineer Walter on the Colorado River.

*Field Office*—Eventually an office of this bureau will be established either in Las Vegas, Nev., or at the Boulder dam site near Las Vegas. For the time being all communications regarding this proposed project should be addressed to the Commissioner, Bureau of Reclamation, Washington, D. C., or to the Chief Engineer, Bureau of Reclamation, Wilda Building, Denver, Colo.; but it is again emphasized that it will be a year or more before contracts can be let for the construction of the dam.

# Economic Features in Design of Sewerage Systems

## Preliminary Studies for Most Economical Layout—Comparison of Eight Alternative Plans

By George O. Consoer

*Of Consoer, Older & Quinlan, Consulting Engineers, Chicago*

MANY and diverse factors affect the development of the most economical design for sewer systems. In fact, this subject is so complicated and so different for each separate locality that very few rules can be made for its application. Textbooks accord it slight mention, although it is one of the most important of the practicing sanitary engineer's problems. On large projects it becomes extremely important and is here closely related to the question of adequate fees for engineering services.

It is clearly to the interest of the engineer's clients that detailed studies of routing, soil conditions, grades and other factors should be made with a view to developing the most economical design for given runoffs. Yet the clients are usually unwilling to grant their engineers proper compensation for this work. Public bodies to which are intrusted the planning and financing of sewer improvements are in many cases notoriously slow in deciding on the sewering of an area, but when they do decide there is a rush to get the plans turned out quickly. This situation also tends to make difficult the proper study of design economy. Consequently many designs are developed with only a general study of the most economical layout with respect to sizes, grades, types of

sewer sections and locations of trunks, branches and lateral sewers. The inevitable result is more outlay than would be necessary provided detailed studies were made. This added expenditure has amounted, in several instances known to the writer, to 10, 20 and even 30 per cent of the total cost.

The only satisfactory method of developing economical design is to make not one design but usually from three to ten or more. Probably the most essential data to make the tests of value are provided by a table of reliable contract prices or a table of cost data for various sizes of sewers laid at various depths in earth, sand, clay, rock and hardpan, and in combinations of such materials. Amazing differences in costs are discovered in varying the size and depth of sewers, particularly where unfavorable soil conditions are encountered. Differences just as great are found by varying the routes, number and location of trunk and branch sewers. In the latter computations the cost of future laterals is vital for ultimate economy.

In developing the design for a combined sewer system to furnish relief for 800 acres of built-up territory and to serve with trunk and branch sewers 1,800 acres of new territory at Calumet City, Ill., the writer had four complete designs worked up, each of which provided for the same runoff and upon cursory examination appeared to be an economical arrangement. Cost figures were obtained from contract bids in the locality and by collaboration with several contractors' estimating departments. Estimates for the four systems varied from $1,250,000 to $1,370,000. Selecting the low estimated design as the best arrangement of trunks and branches, the grades and sizes were varied to produce a further saving of $30,000, making a total saving of $150,000, or 12 per cent.

The subsoil was a coarse wet sand 12 to 20 ft. deep, overlying muck and blue clay. The sand could be drained by well points and dried out. Sewers could be laid at reasonable prices provided grades were kept a foot or two above the muck, but laying in the muck and clay would be expensive, as it involved sheeting. Therefore it became economical to use large sizes of sewers on flat grades at least 12 in. above the clay and muck.

In another instance a design for a small storm sewer was submitted to the writer for check after construction proceedings had been begun. A short study showed that a somewhat different arrangement would effect a saving of more than 30 per cent, the estimates being $22,003 and $16,767, respectively.

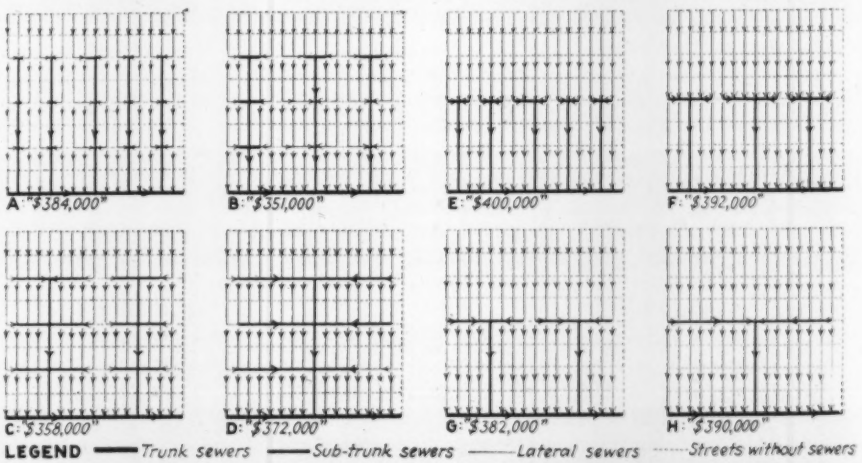
Two general rules are sometimes advanced for economical design in flat or gently sloping territory; (1) to place the trunk in the center of the area to be served, and (2) to lay the trunks at flat grades, reserving as much fall as possible for laterals. These rules have led to numerous fallacies and should not be used unless supported by study for each individual area. In any event they should be amended to provide that any area considered must also be divided into economically sized units for service by trunks and branches.

In many cases two or three trunks are cheaper than one, considering the cost of branches and laterals as well as trunks. Sometimes prior use of one part or another of a system will involve figuring interest charges as part of the cost for the sections to be developed and served in the future. In the accompanying drawing are shown eight methods of sewering 1 square mile of flat land having ordinary soft clay subsoil, with an estimate for each design. These costs are figured from actual contract prices for sewers laid in the northwest suburban area of the city of Chicago.

In rolling country, studies of design economy are of special importance. In many such localities the subsoil conditions change rapidly, and what might appear to be the most economical design, judged from topography alone, may be altered materially when tested by subsurface investigations. At Owensboro, Ky., extremely bad soil conditions of fine sand and muck of various depths made it economical to disregard surface topography to a great extent and build the main trunk sewers almost entirely in deep tunnels through a layer of hard clay about 12 ft. thick and sloping in an opposite direction to the ground surface. This clay is underlain with a coarse wet sand, also unfavorable for sewer location.

Several easements across private property in a sanitary sewer system at Northbrook, Ill., reduced maximum cuts from 22 to 14 ft. in depth and saved more than $10,000 on a $55,000 sewer system, besides making future maintenance much easier.

Infiltration in sanitary sewers is sometimes caused by initial cracking, without failure, of a considerable amount of pipe under backfilling. Cradling with concrete is used extensively to meet such situations. Within limitations as to proper foundation, the use of double or triple strength pipe will usually be found more economical. In choosing between precast concrete pipe and monolithic sewer sections on large projects, the time element is sometimes important to economy. Although it may cost a contractor more per foot to lay the pipe, still the greater ease and speed of construction may cause him to bid lower on pipe, as he can make the same profit or a larger profit on a day's operation. Again, the improvement may be of more value to the property if quickly constructed. This is one illustration of the fact that the fundamental basis of design economy is a study of actual obtainable costs on a specific undertaking rather than mere theoretical and general average costs.




ALTERNATIVE SEWER LAYOUTS FOR FLAT AREA OF SQUARE MILE

In each case the main trunk sewer is the heavy base line; subtrunk sewers and branches are indicated by medium lines and laterals by light lines. Streets in which there are no sewers are shown by dotted lines.

# Field-Welded Pipe Hung on Canyon Walls Carries Water Supply

## Permanent Anchors in Cliff Supported Platform for Welders—Alignment Followed Topography With Angles at Every Joint

By C. J. Ullrich
*Consulting Engineer, Salt Lake City, Utah*

CLINGING to the cliffs 600 ft. above the canyon floor, pipe welders last winter installed a 10-in. pipe line 6½ miles long to bring water to Cedar City, Utah. Practically every joint in this section was made at an angle requiring cutting before welding. No leaks have developed in any of the 1,667 butt-welded field joints made under all kinds of weather conditions. Methods of choosing the best location for the line, of anchoring the pipe to the canyon wall, of following the topography instead of a grade line and of design to eliminate collapse and bursting form the basic topics of this article.

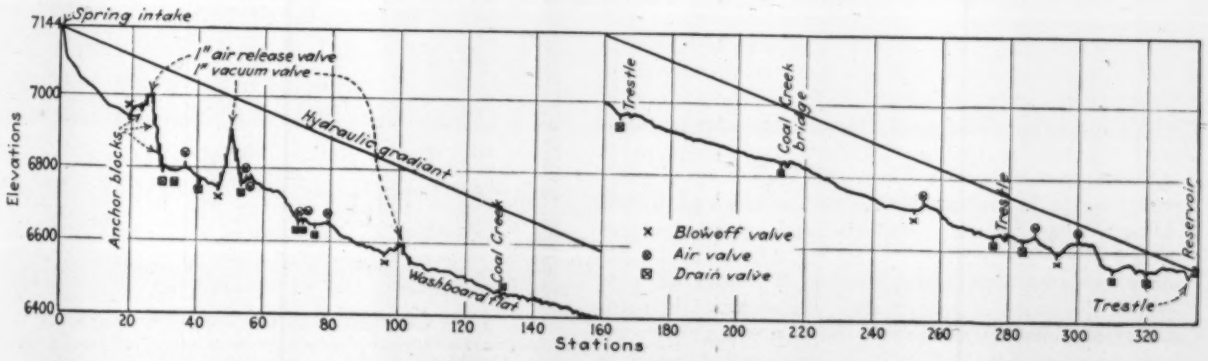
Cedar City, Utah, is a town of 4,000 inhabitants, is the general headquarters of the Utah Parks Company and the starting point of its tours through Cedar Breaks, Bryces Canyon, Zion Park and the Grand Canyon of the Colorado. The establishment of this company in Cedar City increased the domestic water consumption to the point where it had outgrown the municipal supply. A year ago the city acquired the Cluff Spring as an additional water supply and let a contract to pipe this water to the city reservoir. The Cluff Spring issues from the side of a cliff in Coal Creek Canyon, at an elevation of 600 ft. above the canyon floor. The spring consists of a number of separate streams coming from the rock crevices immediately above a 2-ft. coal outcrop. The flow varies from a maximum of 10 sec.-ft. during the spring runoff to a minimum of 1 sec.-ft. during the winter season.

The pipe line installed is a twelve-gage, butt-welded, ingot iron, open-end flow line, 10 in. in diameter and 34,400 ft. long. It has a total fall of 1,234 ft. and operates under a maximum hydraulic gradient pressure of 110 lb. per sq.in.

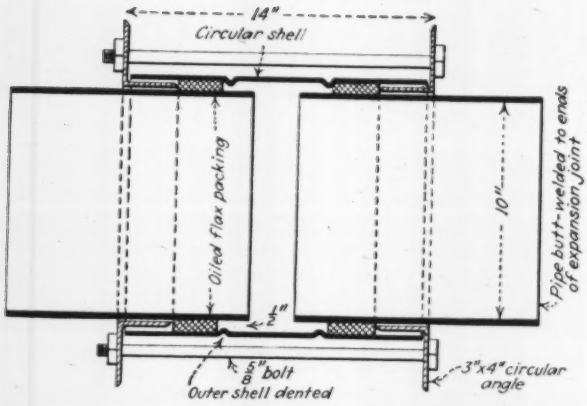
*Location*—In locating the pipe line two routes were available for the first 13,000 ft. One route meant a drop of 600 ft. to the canyon floor in approximately the same distance, then along the bottom of the canyon to the city reservoir. The other route skirted the hillside, coming down to the canyon floor at Sta. 130. The latter route, although it embraced two large inverted siphons and presented a more difficult problem of pipe distribution, was chosen because it was 2,500 ft. shorter, subjected the pipe to less pressure head and avoided side canyons and draws subject to cloudbursts and scour.

TYPICAL HILL COUNTRY THROUGH WHICH PIPE PASSED
Pipe assembled on ground and welded in place in winter.

The topography of the ground traversed by the pipe line is rough and irregular. The line crosses numerous small gulleys, goes over steep ridges and around sheer rock cliffs. Almost every one of the 1,430 field joints had to be cut at an angle. In addition 237 lengths of pipe were cut in half and rewelded at an angle in order to conform to the ground contour. These angles were all cut in the field with acetylene-cutting torches as the pipe was being welded in place.




PROFILE OF 6½-MILE WELDED PIPE LINE




EXPANSION JOINT EVERY 1,000 FT. IN BURIED SECTION, EVERY 500 FT. WHERE PIPE IS EXPOSED

*Hang to Cliff Sides*—In places the hillside slopes along the pipe line were so steep that the welders had to anchor themselves as well as the pipe with ropes tied around trees. Where the pipe line passes around rock cliffs the welders worked from suspended scaffolds. At one point near the lower end of the line where it passes around a rock cliff for a distance of 800 ft., eyebar rods were drilled into the rock wall every 10 ft., projecting 3 ft. from the face of the cliff. Wire cables were passed through the eyes and fastened to similar rods drilled into the cliff 6 ft. above and projecting 6 in. from the face of the cliff. These rods support the pipe line and also supported a working platform for the welders.

Wherever washes were encountered and they were not too deep the pipe line was carried below the bed of the wash; otherwise the pipe line was carried on log trestles. The pipe line crosses Coal Creek twice, going underneath the creek bed at the upper crossing and being suspended from the floor of a bridge at the lower crossing.

*Pipe in Gypsum*—At one point where the line passes through a gypsum formation for a distance of approximately 1,000 ft. it was completely surrounded in the trench with an 8-in. layer of sand to prevent abrasion to the coating while the pipe was being covered.

The entire pipe line except where passing around cliffs and over washes is buried in a trench 18 in. deep. Due to the roughness of the ground, it was found cheaper to dig a shallow trench and cut vertical angles in the pipe line to conform to the topography of the ground than to dig a trench to a more or less uniform grade.

On the steep hillsides the pipe line is anchored to masonry anchor blocks every 150 ft. These blocks are 2 ft. wide by 4 ft. long and are carried well into the ground. Flanged steel collars were welded around the exterior of the pipe at these points and the anchor blocks built around them.

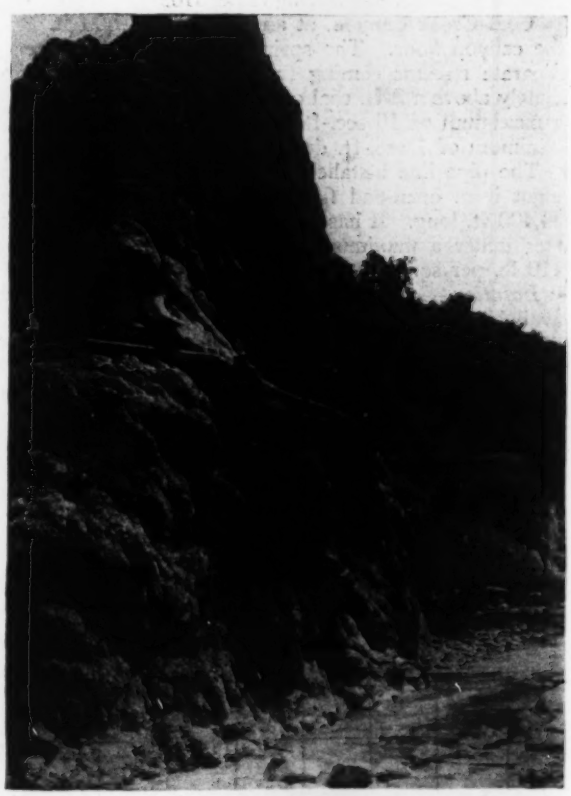
*Fabrication and Coating*—The pipe was fabricated in 24-ft. lengths at the contractor's plant at Woods Cross, Utah. Each length consisted of four 6-ft. sections in which the longitudinal joints were made with an automatic arc-welding machine and the circumferential joints with acetylene-welding torches. Each 24-ft. length was tested for leaks under a hydrostatic pressure of 300 lb. After a length of pipe was tested and inspected it was coated inside and outside by dipping into a vat of specially prepared asphalt base coating to protect the pipe against the action of ground acids and alkali. The manner of applying the coating to the pipe was as follows:

A vat containing the coating material was brought to a temperature of from 350 to 400 deg. F., the pipe immersed and allowed to remain in the vat until it had acquired the temperature of the bath, then raised and allowed to drain off. In this operation most of the coating material drained off due to the temperature of the pipe, leaving only a thin film which acted as a base for the second dipping. After the pipe had partly cooled it was again dipped into the vat and allowed to remain just long enough to become thoroughly coated, when it was raised vertically and the excess coating allowed to drain off. This second dipping put a coating of from $\frac{1}{16}$ to $\frac{1}{8}$ in. thick on the pipe. Test of the coating in the field last winter showed it to be fairly pliable at zero temperature.

After the pipe was assembled in the plant it was shipped to Cedar City, where it was loaded on wagons and hauled to the nearest accessible points along the line. From these points the pipe was distributed by man power. Distributing the pipe along the steep hillsides required three men to carry a 24-ft. length.

In assembling the pipe in the field an acetylene-generating set was mounted on a truck and run along the pipe line. Where the line was inaccessible to the motor truck oxygen and acetylene tanks were distributed along the line and used. After a field weld was made and before the metal cooled the inside of the joint was swabbed with a circular brush dipped in the coating material and inserted in the open end of the pipe to the joint and then rotated. The outside of the joint was similarly coated with a hand brush.

*Safety Measures*—To provide against air locking of the pipe line 1-in. air-release valves were installed at all



PIPE WELDED IN PLACE ON CLIFF WALL
Practically every joint was made at an angle; part of the metal being burned out before weld could be started.

major high points in the line. At these same points 1-in. air and vacuum valves were also installed to prevent the collapse of the pipe in case of a break along the line. At all major low points 3-in. blowoff valves were installed. At all secondary high points ½-in. pet-cock type air valves were installed and at all secondary low points 1-in. drain valves were installed. All told, there are 36 of these auxiliary valves. There is no shutoff valve in the line itself or at the outlet end, so that the full hydrostatic head can never be thrown into the line.

Expansion joints were placed in the line every 1,000

LOCATION OF LINE IN FLOOR OF CANYON

ft. where buried and every 500 ft. where the line is exposed.

*Progress*—The actual laying of the pipe in the field began in December, 1927, and was completed in April. Laying progressed through all kinds of winter weather, with the thermometer registering as low as 10 deg. below zero. After the line was completed and the water turned in a complete inspection was made covering a period of two days and not a single leak was found in the entire line. The writer attributes the remarkable results obtained in the field welding to the fact that the ingot iron melts and flows uniformly under the heat of acetylene torches without developing gas pockets.

The writer acted as consulting engineer for Cedar City on this work. The contract for furnishing and laying the pipe was let to the Burnham Manufacturing Company, Woods Cross, Utah, while the hauling and distributing of the pipe and the trenching was let to local contractors. The total cost of the completed line was $55,000.

# Continuous Beam Design Practice Brought Up to Date

## Especially Referring to Reinforced Concrete Where Correct Design Is Necessary for Efficiency and Safety

By Marshall G. Findley

*Structural Designer, Harbor Commission, Milwaukee, Wis.*

THE DESIGN and detail of continuous beams in modern structures has in the past twenty years received very careful attention. Building codes have been revised so that recognition of restraint and continuity is the rule. Systems of coefficients for positive and negative moments have been proposed and used with varying degrees of safety and convenience. And several suitable methods of more exact analysis are in quite general use for cases not properly covered by building code coefficients.

In spite of this attention, it is surprising how often designers need information on certain practical features of continuous-beam design in reinforced-concrete structures. The purpose of this article is to summarize a number of practical suggestions on the subject for convenient reference. Very little of the article is original, but it seems of value because no such summary has appeared in recent years.

*Comparison of Continuity in Steel and Concrete*—When steel beams or girders are designed as simple and erected continuous, an increased factor of safety usually results. Such design, although not economical, causes no trouble after erection. Consequently many steel beams are still designed as simple beams which are wholly or partly restrained by the connections at the supports.

With reinforced-concrete beams the case is entirely different. Here the design as a series of simple beams may even be more economical than as a continuous beam, but it is not in general safe. Negative moment cracks near the end of a beam so designed may be increased by shear, such cracks giving access to moisture which causes rusting of the reinforcement and spalling of the concrete. In some cases a concentrated shear may even cause failure of the beam.

Thus the primary purpose in designing a beam as continuous may vary. With steel or timber this purpose is usually economy. With reinforced concrete the primary purpose is the prevention of negative moment cracks, with a secondary advantage of economy in some cases. In other cases reinforced-concrete beams designed as continuous will prove more expensive than a series of simple beams, although considerations of safety and appearance usually lead to the adoption of the continuous design in any event.

Many features of continuous design, as with all varieties of design, cannot be reduced to standardized practice, but must depend for successful development on the common sense and ingenuity of the designer. On the other hand, there are some features of continuous design which may be in a measure standardized. These are here considered in three groups: (1) building code coefficients, (2) methods of exact theoretical analysis and (3) a number of practical suggestions and warnings with comments on their practicability.

*Building Code Coefficients*—Building codes govern continuous design with only partial success. The best

code now in use is of course that of the Joint Committee, although even with it there are certain gaps, particularly in the treatment of T-beams and haunched beams. The moment coefficients given are approximately correct for continuous beams under a certain limited set of conditions, but may be either unsafe or uneconomical for other conditions. They are probably safe when the interior spans are equal, when the moments of inertia of the section are constant throughout all spans, when the total load per foot is constant throughout all spans and when the live-load is large in proportion to the dead-load. The coefficients are definitely unsafe when end spans are considerably smaller than interior spans, or when a very short or a very long span occurs between two average spans. The coefficients are definitely uneconomical when the live-load is small in proportion to the total load and

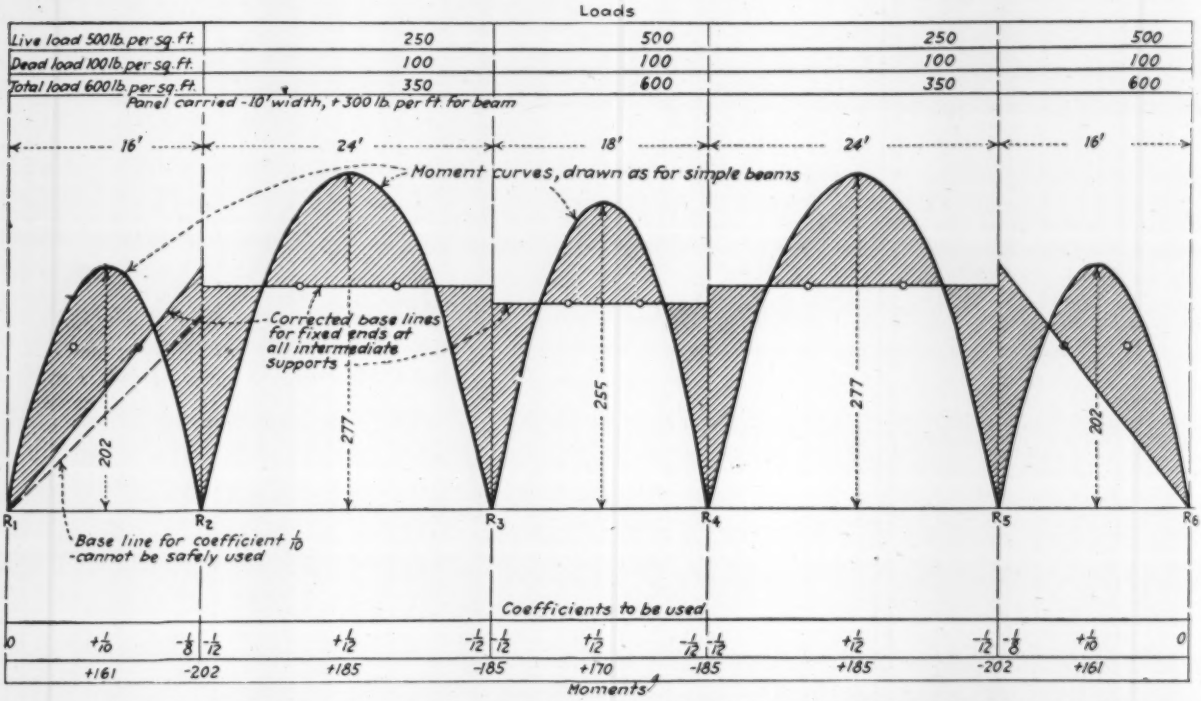



DIAGRAM FOR CHECKING THE USE OF BUILDING CODE COEFFICIENTS IN CONTINUOUS BEAM DESIGN
Method is a variation of that of superposed base lines. The diagram is made up of approximately the correct moment curves for full loads on all spans.

in the case of beams with heavy haunches. The coefficients are uncertain as to accuracy when spans, moments of inertia or loads vary throughout the length of the continuous beam.

With these limitations kept clearly in mind, the designer will find building code coefficients very helpful. However, even in an ordinary building where continuous beams are used, several exact analyses by the best theoretical methods available could be carried out.

*Methods of Theoretical Analysis*—Several methods of theoretical analysis for the continuous beam are in current use. The choice of the best method for a particular case is often a personal matter. Some designers prefer graphic methods. Others prefer algebraic solutions. One designer may choose a conservative method, where another selects the latest novelty. One designer will follow definite instructions while another, basing his work on general principles, will vary his method each time he uses it. Generally the best results follow if each designer can be allowed to select his own methods, although each method has some special feature or circumstance of applicability that is important.

The *three-moment theorem*, if available in usable form, usually provides the quickest solution and is most easily checked for an algebraic-minded designer. It occurs in many forms, perhaps the most general being that given on p. 135, Parcel and Maney, "Statically Indeterminate Stresses." It is also very clearly stated and developed in Bulletin 108 of the University of Illinois Engineering Experiment Station, p. 33. The equations are readily modified for different locations of live-load. In the case of a beam of many spans, however, this method often leads to a rather complicated set of simultaneous equations. It is difficult to apply when supports are yielding or ends only partly fixed.

The *fundamental equations* giving the relation between load, shear, moment, angular distortion and deflection are sometimes very useful. The writer believes that every designer of continuous beams should understand these equations and know how to apply them, for difficulties occasionally arise that can be overcome only by reverting to first principles.

The *slope-deflection methods* as stated by Parcel and Maney, p. 147, "Statically Indeterminate Stresses," is most useful for analysis of cases involving yielding supports or partial fixation of ends. This method also requires a very complete understanding of the elementary principles of continuous beam action. For ordinary cases it is not the quickest method.

The *method of superposed base lines*, using so-called "characteristic" and "conjugate" points, is the quickest method for the eye-minded designer under ordinary conditions. This is found in Fidler's "Practical Treatise of Bridge Construction," 1924 edition, p. 134. Many American designers have learned an improved form of Fidler's method directly or indirectly from Professor

Ostenfeld, of Copenhagen. A similar method, and one easier to find for reference, was published by Nishkian and Steinman in Vol. 90, *Transactions*, Am.Soc.C.E. This latter article is especially clear on the application of the method to unsymmetrical loadings, varying moments of inertia and settlement of supports.

For many years the writer has used the first steps of this method to ascertain whether or not it is proper to apply the building code coefficients. In making this determination lines fixed by the two characteristic points of each span are drawn to the end of the span. If in all adjacent spans the lines happen to strike the common reaction line at points close together, it is probably safe to use the code coefficients. Full load on all spans is assumed. The end spans require special consideration.

The accompanying diagram illustrates this method. The corrected moment base lines shown are those obtained by assuming all spans fully restrained at all supports except the free ends. The relation is such that $\frac{1}{8}WI^2$ must be used for the moment at the restrained end of each end span, but otherwise the code coefficients are safe. The diagram as it stands is approximately the correct moment diagram. It is quickly drawn, and if not satisfactory, it at least gives a basis for working out the correct moment diagram by Fidler's method. After some experience in using this method, tests can be made by a few computations and perhaps a rough free-hand sketch.

Under some special conditions, *Maxwell's theorem* and analysis by application of unit weight is a very valuable method. Closely related to it is the use of *influence lines*, which are especially valuable in the location of maximum effects due to a system of moving concentrated loads. For instance, a two-span continuous girder may be very easily analyzed by drawing the moment diagram for the whole length of span with a unit load applied at the point of intermediate support. This moment diagram is then used as an influence line for variation of the center reaction under moving loads crossing the girders. This makes a quick trial of a number of positions of loads convenient and even a theoretical test for maximum effects possible.

The use of *mechanical methods*, usually by means of models, is coming to be more and more used in exceptional cases of large and unusual girders. Such methods are largely due to Prof. George E. Beggs of Princeton University, and the designer should follow up this investigator's published writings.

*Miscellaneous Suggestions*—The following suggestions will serve as a rough check on certain rather common mistakes. In general the rules refer particularly to continuous beams in reinforced concrete.

1. Spans and dimensions may often be so adjusted as to obtain ideal conditions for use of code coefficients. In general, this is accomplished by using shorter spans for heavier live-loads, although in some cases it is possible to make the adjustment by using heavier beam sections. Only repeated trial will give satisfactory adjustment.

2. It is theoretically an error to make the end span about 8½ per cent shorter than the interior spans and then assume that $\frac{1}{10}WI^2$ for the end span becomes equal to $\frac{1}{12}WI^2$ for the interior spans. Exact analysis will show that the true negative moment at the first interior support becomes greater than either of these values. If the end span is to be shortened for economy, it should be reduced about 18 per cent, although in this case the code coefficients cannot be used. The moments used should be $\frac{1}{8}WI^2$ for the end span and $\frac{1}{12}WI^2$ for the second span.

3. It is in general economical to design a T-beam or a rectangular beam with approximately constant moment of inertia to allow application of code coefficients.

4. The moment of inertia of a properly designed concrete beam, either T-type or rectangular, is approximately proportional to the product of the tensile steel area and the square of the depth from the compression face to the center of the tension steel; if the depth is constant, the moment of inertia is of course proportional to the area of the tension steel.

5. Considerable variations of moment of inertia in the region of the quarter-point of the span do not seriously affect the computations, provided a considerable length of beam near the points of maximum moment has the assumed moment of inertia.

6. A common practice used to vary the moment of inertia is to add steel at the mid-span. Under such conditions, if the coefficient $\frac{1}{8}$ is used for mid-span, the continuous junctions at each support should be designed for 60 per cent as great a moment of inertia, using the coefficient 3/40. This method is not economical and if possible should be avoided. The old rule of thumb that the resistance added at the center of a span may be subtracted at each support does not work.

7. There is slight theoretical economy gained by haunching. In ordinary buildings haunches are not desirable, but in an occasional beam may be used to advantage.

8. A short span adjacent to a long span should have some top steel for the full length of the span.

9. A uniform live-load equal to or greater than the dead-load calls for some top steel for the full length of all spans.

10. One theoretical analysis of a continuous beam for a single case of loading is never enough unless the load is all dead-load.

11. Bond between reinforcement and concrete requires careful attention. As a rule, bond area must be provided by the top steel at a continuous junction and by the bottom steel at a truly free end. Where partial fixation exists, bond area may require either top or bottom steel or both.

## Opportunities for Engineers in U. S. Civil Service

In a pamphlet entitled "Opportunities for Engineers in the United States Civil Service" the United States Civil Service Commission outlines the opportunity for the acquisition of diversified engineering experience that the government offers. The pamphlet points out that included in the federal civil service are more than 3,500 professional engineers. The activities of this force embrace every branch of endeavor to which engineering is applied.

There are eight grades of engineers for which civil service examinations are held. The number of engineers in each grade, together with the range of salaries in each grade, are as follows: Four chief engineers, $8,000 to $9,000; five head engineers, $6,500 to $7,500; 170 principal engineers, $5,600 to $6,400; 665 senior engineers, $4,600 to $5,200; 91 engineers, $3,800 to $4,400; 1,094 associate engineers, $3,200 to $3,700; 954 assistant engineers, $2,600 to $3,100; 553 junior engineers, $2,000 to $2,600.

In each grade, in addition to the minimum and maximum salaries, there are intermediate salary gradations. Promotion is made from grade to grade.

# Street Cars and Buses in Traffic Transportation Plan

## How to Obtain Higher Speed, Greater Capacity, Better Routing and More Efficiency Out of Mass Transport Agencies

SINCE IT IS PATENT to any one who has given the least technical study to traffic problems that street railways and motor buses will continue for many years to be the backbone of the mass transport systems of our great cities, a close review of their respective places, problems and relations to automotive traffic is highly essential. First, it is essential to get into the heads of traffic men and city planners a fuller perspective of the nature of mass transportation by rail with auxiliary bus services, and, second, it is essential to encourage the railway industry along lines of economic research on their own systems. Since they carry the bulk of the riders, theirs should be the major responsibility for the assumption of technical leadership.

While columns of opinion have been forthcoming, far more facts and trend evidence are needed on which to base opinions that have in them efficiency and economy for the transport agencies and adequate service and traffic facility for the public. The basic index of this strange situation is the riding habit, which in the end reveals relative service. Mr. Bibbins, in a paper of which the following is an abstract presented before the Philadelphia Engineers Club, Oct. 16, at a conference on "Expediting and Controlling City Traffic," discussed basic information as well as methods of improving existing facilities to the end that higher speed, greater capacity, better routing and more efficient operation may be attained.

Mr. Bibbins' long experience with the complicated traffic situation in Chicago with Bion J. Arnold, that veteran of railroad and street traffic experts, has been widely extended in recent years into the bus field. His 25 years' contact with transportation in its various phases well qualifies him to speak his opinions on the subject. Principally, however, he uses facts drawn from his researches and experience.—EDITOR.

TRANSPORTATION is one of the first essentials to healthy community life, and in this paper it is dealt with as such rather than as a nuisance. Mass transportation is all too often considered in terms of vehicle congestion, with little reference to the dynamics, technique or volume of transport in the mass. Large cities double in population in about 30 years, land values increase about three times and railroad freight and passenger traffic of the country from seven to eight times. Passenger movement increases about as the square of the population, but to the private automobile mass transport agencies have lost one-third of this riding habit. However, it would take more than 2,500,000 autos to handle the rush-hour load of our 22 large cities of over 75,000 population. The impossibility of running this vast fleet renders imperative the maximum preferential use of large-capacity vehicles. Surface electric railways, which carry well over ten times the traffic of the steam railroads, a billion per year, must continue to function for some time to come as the backbone of mass transport, supplemented by motor buses. About 20,500 buses were in operation in 1927, according to U. S. Census returns. Of these, 8,500 were operated by street railways. But as noted in the table the high-water mark of the bus has passed.

| | | No. of Companies | Added Route Miles | Added Buses | Buses Per Mile |
|---|---|---|---|---|---|
| August, | 1923 | 99 | 1,008 | 594 | 0.76 |
| | 1924 | 138 | 1,312 | 1,118 | 0.80 |
| September, | 1925 | 251 | 9,705 | 2,566 | 0.37 |
| | 1926 | 338 | 2,839 | 2,104 | 0.44 |
| | 1927 | 367 | 1,831 | 1,831 | 0.50 |
| | 1928 | 364 | 161 | 1,234 | 0.53 |

Methods of improving the functioning of the transport lines are increased speed; close headway, which means capacity; better routing, and more efficient operation.

*Higher Speed*—The highest possible average operating speed is the greatest need today to reduce congestion caused by individual transport and to recapture the lost riding habit.

In a 1,000,000 class city I recently found rush-hour trolley speed on a main trunk street as low as 4 m.p.h., and on some stretches as low as 1½ m.p.h. where the cars operated on a headway of 22½ seconds, some lines running from 30 to 50 per cent behind schedules. System speed on the street for the year was barely 9 m.p.h., while bus lines averaged 9.9 m.p.h. running speed.

In another large city, a good example, the system speed averages 11.2 m.p.h. running speed for the system. During rush hour, lines in the downtown loop, which has co-ordinated wave signals, run 6 to 7 m.p.h.; lines outside 1_ m.p.h. When one considers that a two-track rapid-transit line like those in Philadelphia can run only 16 to 17 m.p.h. without express service, a rise from 9 to 11 m.p.h. system speed becomes significant. But it is still too slow for all auto users. This raises very seriously the question whether (in the absence of express rapid transit) we have not got to develop limited stop, long-haul bus service from downtown to outlying centers and suburbs, even at higher fare, to attract the motorist. For with a few intermediate stops they may approximate rapid transit speeds.

But the main problem is the street railway trunks. Much can be done by "protecting" these essential streets with "Stop as You Enter" signs judiciously placed. Curiously enough some cities have erected these signs *against* instead of *with* the railway traffic, thus imposing more car stops. Some cities prohibit parking on the inbound side of the trunk line in the morning and the outbound side in the evening, which usually doubles the effective street capacity and relieves the car lines. On the same principle four-lane trunk car-line streets should be cleared on both sides through heavy districts. These regulations should rest upon a carefully designed traffic thoroughfare plan, and each section of street and each important intersection should be studied separately to secure the best freedom of movement.

Traffic signaling may be either obstructive or beneficial to mass transport, and no rules can be laid down applying generally. There has been too much copying, because "other cities do it." Railroad signaling has supplied much of the technique, and tramcars, like trains, should be kept on the move, not forced to "hit and run" through unco-ordinated signals. The short signal cycle, adjustable both as to length or cycle and to split timing according to the traffic density, rush and non-rush, and the co-ordinated wave system of speed control have proven most effective. The speeding up of operations in Chicago is an outstanding result of the policy of close co-operation with railway engineers in securing a system best suited to the needs of *both* transit and traffic rather than traffic *alone*. Here net running speed increased 10 per cent within the last five years and revenue passengers increased 16 per cent.

*Density and Capacity*—Rush-hour movement today is demanding headways or car spacing as short as nine-

teen seconds on Wabash Ave., Chicago, and 22 seconds in Philadelphia, Montreal and even Washington. As these close headways are about the loading time at the heaviest loading point, the maximum capacity of the lines has already been reached or exceeded. In fact, below 30-second headway the line is usually slowed down, for capacity varies inversely with the speed. Of course, troubles multiply at heavy crossings—for example, Chicago handles nearly 300 cars in the maximum 30-minute, six-day movement; Montreal's heaviest crossing, 373 cars in the maximum hour, four-way movement.

Modern car lines should realize a rush capacity of 10,000 to 12,000 passengers per hour with reasonable speed and requiring but one fixed traffic lane about 10 ft. in clearance width. Many systems do not realize these full possibilities, however. That is our present problem.

Motor buses, on the other hand, although requiring no track, have their own serious limitations in such denser service as 20- to 30-second headway, largely because of their lack of peak overload capacity, platform space, door width and accelerating speed, in comparison with the railway car.

*Routing and Operation*—The routing of a railway system and scheduling of its service is probably the greatest source of loss or gain in the whole business, requiring constant and watchful care and readjustment to meet ever-changing riding habit. This phase involves the franchise question, the personality of management and the general resistance against change.

I confess to some feeling of depression to find companies still struggling with complicated central loops, overloaded throats, inconvenient transfers and, as "the last straw," a transfer charge to add to discouragement of riding. In one city where this "town pump" idea still prevails I found that the average rider spent more time navigating these central loops than to ride home. As a result autos were actually moving as many passengers as street cars out of the central district, even during rush hours. A large part of this auto traffic was clearly crosstown, indicating a positive demand for through routing, which could easily have been obtained by rail.

Wider distribution of routes, cars and loading points throughout the central district is often needed, for concentration inevitably brings about serious curve interferences and stalling of lines, bringing added traffic congestion. Multiple-berthing cars for loading and movement through crossings, virtually train operation, also increase both line capacity and speed.

Efficient routing often requires unification by agreement if not by ownership. The national capital is a good example of this need. Here two systems have grown up in competition. When unification is permitted by law, great improvements in facility of travel through and across the city will be possble both by car and by bus lines. Here the city planner is also involved. While Washington is widely heralded as an example of a city ideally planned, nearly all of the main arteries have traffic obstructions in the form of buildings or public squares. As a result, each system has to operate important routes with 40 or more turns, round trip, of 90 deg. or sharper.

*Operating Efficiency*—Street railway companies, as is the case with the railroads, shy at the idea of engineering analysis and economic research as applied to the transportation departments. Yet this department has primary control of nearly half of the operating costs, and on the efficiency of routing and schedules largely rests the success or failure of the whole service. I believe this is the main road to a recapture of the lost riding habit. The same reasoning applies to motor-coach operation.

What can be done is illustrated by recent studies in which we found by rerouting, cutting competitive service and layovers, simplifying the terminal trackage, through routing, distributing terminal service, etc., a money saving of over $600,000 per year would be obtained with much more convenient service to the public and an increase in runnning speed, also a better approximation of the actual origin-destination movement of riders. Chicago is another striking example of engineering analysis and research. The 1924 terminal rerouting saved in trainmen's wages at the rate of $460,000 per year, released 41 cars for service elsewhere (an equivalent investment of $600,000), eliminated 1,000 turns per day on 35 routes and generally speeded up operation.

Enough opportunities exist for improved routing, scheduling, operation and line speed, and with protected streets and scientific traffic control, so that the mass transport systems may not only regain a very considerable share of their lost riding habit but also give the companies and cities a good breathing spell for careful study and planning of their future systems, both surface and rapid transit. Thus practical control over the development of the city may be exercised in a highly beneficial fashion to the best advantage of its residents rather than letting the city develop helter skelter with transportation two or three "jumps" behind. This would be real city planning and efficient management.

# Hand and Machine-Spread Asphalt Costs Compared

## South Carolina Black Top Operation Shows Gain in Production and Smoothness With Material Saving in Cost

By J. Frank Tuttle

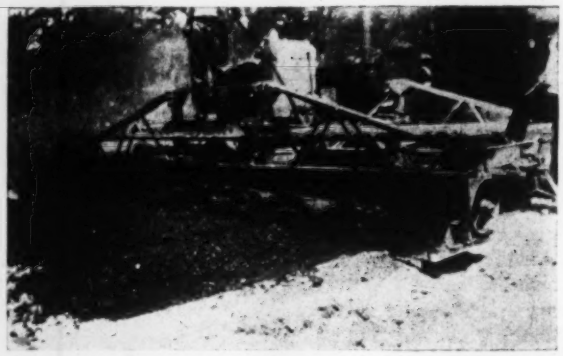
*Assistant Division Engineer on Construction, Florence, S. C.*

MACHINE-FINISHED asphalt was used first in South Carolina last year on a state project in Florence County. Following this trial more than 40 miles of black top was constructed in the same manner. The Florence road was the standard section of 2 in. of asphaltic concrete on a concrete base with 2-in. curbs or headers to retain the black top. The resort to machine was prompted by learning of its use in Oklahoma, by the trouble which had been experienced in securing a surface by hand raking that would meet the specification limit of ½-in. variation in 10 ft. and by an agreement of the contractor and the manufacturer to undertake the experiment without obligating the state highway officials beyond formal approval if the results were satisfactory.

With the decision made to undertake machine finishing care was taken to get exactness in the concrete base and particularly in the horizontal profile of the curbs or headers. The base forms were set to straight-edge and when the curbs had set (the morning following concreting) they were straight-edged and all variations removed by carborundum brick. As the asphalt-finishing machine was to travel on the concrete headers, this exactness of

grade was considered essential to smoothness, which was the object chiefly in view by the state highway engineer in using machine finishing.

There was some trouble at first in learning how to run the machine, but this disappeared with experience. The greatest problem was to determine the proper height to set the screed in order to get exactly a compressed thickness of 2 in. After half a day of experimenting, the screed was set at 3 in. This height proved satisfactory for all the remaining work. In starting work it was found necessary before the arrival of the first load of material to heat and oil the screed. A blowtorch and gasoline were used; the screed was heated up to 250 deg.



SCREED PLANING DOWN BLACK TOP AS DEPOSITED BY SPREADER BOXES

The heating was necessary so that the screed would iron out and slide over the material instead of dragging it. Trouble was also had at first because of the different heat of different loads, which caused uneven distribution by the screed. With a hot load, say 350 deg., the material would smooth out and compact, whereas with a cold load the coarse aggregate would pull out and the mixture would drag and leave a porous surface. It was found finally that a temperature of about 325 deg. gave the most workable mixture.

The first method used in placing the asphalt ahead of the machine was a dumping board and hand cutting. This was satisfactory, but it called for six men at a cost of $18 per day to handle the material. To reduce this cost, patented spreader boxes which required only two dumpers were substituted at a cost of $5 per day.

The procedure behind the machine was as follows: As soon as the screed had passed over the material and spread it, the three-wheel roller followed for the initial seal. Immediately after the roller moved back, the back-surface men were on the road with straight-edges, making all necessary corrections while the material was still hot and might be disturbed or added to and resealed by a second trip and not show a correction after the final rolling. If the corrections are not made until the material has cooled it is hard to disturb or add to it and it may have to be cut out and patched. After the second or third rolling by the seal or three-wheel roller had been completed, the 8-ton tandem roller came on and rolled the entire surface at 45 deg. to the center line. Then the contractor's straight-edge man made a second check of the entire surface and marked any variations. He also directed the tandem roller operator in rolling out the irregularities and checked them again. After all irregularities had been rolled out and checked, the department's inspector, prior to the application of the squeegee coat, made a third and final straight-edge check.

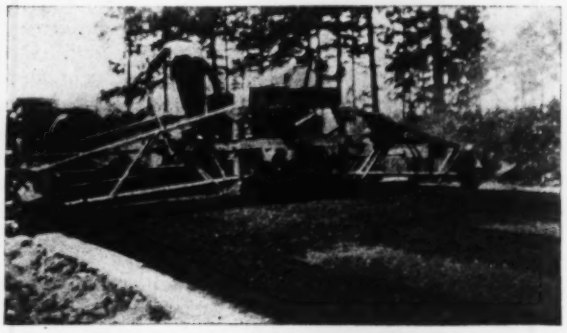
It is impossible to say how much material this machine would have spread in a day, as we were limited by the output of the plant and the square yard capacity of the rollers. However we placed 2,500 sq.yd. in a day's run with no increase in labor. The approximate comparison of cost as shown below lists the entire crew for both the hand method and for the machine with spreader boxes:

COMPARISON OF COST OF HAND METHOD AND MACHINE METHOD OF SPREADING ASPHALT

| | | | |
|---|---|---|---|
| **Hand Method** | | | |
| Five rakers | at | $0.50 per hour | $25.00 |
| Six cutters | at | 0.30 per hour | 18.00 |
| Two roller operators | at | 0.60 per hour | 12.00 |
| Dump man | at | 0.20 per hour | 2.00 |
| Two squeegee men | at | 0.30 per hour | 6.00 |
| Two sweepers | at | 0.20 per hour | 4.00 |
| Two miscellaneous | at | 0.20 per hour | 4.00 |
| Foreman | at | 0.70 per hour | 7.00 |
| Total daily labor cost | | | $78.00 |
| **Machine Method** | | | |
| Three rakers | at | $0.50 per hour | $15.00 |
| Two dumpers | at | 0.20 per hour | 4.00 |
| Two roller operators | at | 0.60 per hour | 12.00 |
| Two squeegee men | at | 0.30 per hour | 6.00 |
| Two sweepers | at | 0.20 per hour | 4.00 |
| Machine operator | at | 0.30 per hour | 3.00 |
| Straight-edge man | at | 0.40 per hour | 4.00 |
| Two miscellaneous | at | 0.20 per hour | 4.00 |
| Foreman | at | 0.70 per hour | 7.00 |
| Total daily labor cost | | | $59.00 |

The labor cost saved by the machine was therefore approximately $20 per day.

The fine surface secured by the machine was almost unbelievable and far beyond our expectations. An accurate check was made of both hand-raked surface and machine surface by means of a 32-ft. straight-edge with readings taken at 1-ft. intervals. Five sections were taken of each method at random over the project and the average variations in 32 ft. were as follows: For machine finish, $\frac{3}{32}$ in.; for hand finish, $\frac{4}{32}$ in.



BLACK TOP AS LEFT BY FINISHING MACHINE AND BEFORE SEAL ROLLING

The contractor for the work was the Robert G. Lassiter Company, Raleigh, N. C. G. H. Moorefield, Columbia, S. C., is state highway engineer.

## Correction

In the article, "Old North Station at Boston Replaced by a Modern Structure Including a Coliseum," there were two typographical errors. At the top of p. 340 the article stated that ample stairways were provided on the basis of 20 ft. in width for each 100 persons for whom seats are provided; it should have read 20 in. instead of 20 ft. At the bottom of p. 341 the article stated that the live load in general is 100 lb. per sq.in.; it should have read 100 lb. per sq.ft.

# Effect of Sugar on Concrete in Large-Scale Trial

## Unusual Case Cited of Results Where Definite Quantities Were Introduced to Retard the Set

By Miles N. Clair

*Construction Engineer, Thompson & Lichtner Company, Boston*

LITERATURE on the effect of sugar upon concrete is surprisingly incomplete, perhaps due to the fact that only under exceptional conditions can sugar be accidentally introduced into concrete. That sugars, alcohols and fruit juices, even in small quantities, greatly retard the setting of cement and destroy the strength of the concrete appears to be generally known, and the accidental incorporation of sugars in the mix is carefully guarded against.

A number of cases have come to our attention in the past where the use of water containing waste from refineries and fruit-canning plants and the contamination by sugar of cement and aggregates during shipment or use has resulted in defective concrete. Recently, however, an unusual case arose, where in the treatment of floors the contractor had introduced sugar in definite quantities for the purpose of retarding the set.

*Sugar Used as Retarder*—In a structure to be used for cold-storage purposes the floor construction consisted of a structural slab, 6 in. of cork insulator, 2 in. of 1:2:4 unreinforced stone concrete, and 1 in. of 1:1:1 surfacing. The plan was to pour the 2-in. slab in the morning and the 1-in. topping in the afternoon, and to steel-float or finish the topping the next day. Although the work was being done during cold weather, it was considered necessary to use a retarder so as to keep the topping from setting overnight. The contractor decided on sugar as a proper retarder, and he started with 1 lb. per bag of cement, or about 1 per cent.

The topping with 1 per cent of sugar did not set up sufficiently by the next day, and therefore the quantity was cut down to ¾ lb., and then progressively to ½ lb., ¼ lb., ⅛ lb., and finally to nothing. The result was a beautiful large-scale experiment (7,000 sq.ft.) on the the effect of use of sugar as a retarder in concrete.

*Its Effects*—Examination of the slab at the age of 25 days showed the portion with 1 lb. of sugar to be easily scratched with a blunt instrument and easily dug out with a pocket knife. The 2-in. slab under this section was also affected to a depth of ½ in. The sections of topping containing less sugar were harder, the deleterious effect of the sugar being very apparent for ½ lb. and more per bag. The topping containing ¼ lb. showed some effect of the sugar, while that with ⅛ lb. was only slightly less hard than the slab without sugar. The section without sugar had set properly. The sections containing ¼ lb. to ¾ lb. had a surface crust of about ⅛ in. which was hard and did not scratch readily, although the material below was soft.

In order to determine whether there was any possibility of the topping hardening, portions of the concrete containing 1 lb. of sugar were dug out with a pocket knife and taken to our laboratory, broken up in a mortar and regaged with 11.5 per cent of water, which gave a semi-fluid consistency. This material was made into 2-in. cubes. The cubes hardened in air within a few days and at 28 days showed a strength of 360 lb. per sq.in. in compression. When placed in water at four days, cubes of this material softened and disintegrated. Cubes placed in sodium silicate at four days showed [illegible] increase in surface hardness at 28 days over the cubes stored in air; the surface of these cubes could barely be scratched with a pocket knife, but the mortar below this surface was soft, powdery and of low strength. Other laboratory tests were also made on pieces of the topping representative of all parts of the slab to determine the possibility of the concrete ever attaining satisfactory strength and to determine means of accelerating the gain in strength.

*Confirmatory Facts*—The slabs had to be used within a short time and it was therefore recommended, on the basis of the laboratory tests and examination of the slabs, that the portions of the slab containing ½ lb. to 1 lb. of sugar be removed and replaced. After eight months an examination of the slabs, which are subject to severe abrasion along certain lanes, showed appreciable wear in a section containing ½ lb. which had been allowed to remain, slight wear on the ¼-lb. section and none elsewhere.

Experiments on a large scale, such as was made in this case, are instructive not only in the information they give (which, incidentally, could be obtained at considerably less cost by proper laboratory tests), but also because they show the extent to which available information in regard to concrete has not been assimulated by the usual successful engineer and builder.

## Water Third in Cause of Typhoid Outbreaks

Epidemiologists of the State Department of Health of New Jersey put milk first, other foods second and water third as the medium of infection in typhoid outbreaks that have been studied within the state during the past twenty years. The conclusion is drawn from investigations of 180 outbreaks of typhoid fever and one of paratyphoid, resulting in 2,643 cases. According to the December issue of *Public Health News*, the official organ of the New Jersey State Department of Health, the causes for the typhoid outbreaks stand in the same order, "whether the number of outbreaks or the number of cases are used as the basis of division." The article states that "happily" pasteurization of milk "is being used to a greater extent each year." This furnishes a practical and inexpensive method for reducing the chances of typhoid, as well as several other diseases, being spread by milk, while "in the case of other foods thorough cooking will destroy any infection that may have been introduced, and foods served hot are practically always safe," yet "unfortunately for the cause of disease prevention some articles of food cannot be served hot without destroying their appetizing qualities." An example is most recently afforded by a typhoid outbreak caused by chicken salad served Sept. 14, 1928, at a church supper in Freehold, N. J., which led to 36 cases of typhoid and four deaths, one of the cases having been definitely shown to be a secondary case. Laboratory examinations of the bodily discharges and of samples of blood collected from 45 persons who took part in preparing the chicken salad showed typhoid bacilli present "in a specimen of feces from one of the persons who assisted to some extent in cutting up the chicken and celery." About 500 persons attended the Freehold supper, with only 38 cases of typhoid reported among them. An earlier outbreak in Burlington County, New Jersey, resulted in 201 cases among about 300 people who attended a supper where salad was served.

# Engineering Literature

*A Monthly Review of Books and a Listing of New Publications*

## Professor Babbitt's Sewerage Revised

REVIEWED BY JOHN H. GREGORY
*Consulting Engineer; Professor of Civil and Sanitary Engineering, Johns Hopkins University, Baltimore, Md.*

SEWERAGE AND SEWAGE TREATMENT—By Harold E. Babbitt, M.Am.Soc.C.E., Professor of Sanitary Engineering, University of Illinois—Third Edition. New York: John Wiley & Sons. London: Chapman & Hall. Cloth; 6x9 in.; pp. 545; 194 halftones and line cuts. $5.

The first edition of this book appeared in 1922 and the second in 1925. In the second edition the author responded cheerfully to criticisms of the first edition, and the third edition is a material improvement over the second. As with the first edition, the book still stands as one designed to meet the needs of students and teachers in the classroom as well as those of practicing engineers.

In the new edition minor revisions have been made covering sewer design and construction, and more extensive revisions and additions to that part of the book devoted to sewage treatment, as in the chapters on dilution, activated sludge and sludge treatment, as well as in the comparison of different processes of sewage treatment. To the design and construction of sewerage systems 321 pages are devoted; to sewage treatment the remaining 211 pages.

Taking the book as a whole, it is a very creditable piece of work, but, as stated by the present writer in his review of the first edition (*Engineering News-Record*, April 20, 1922, p. 659), the book should preferably be in the hands of an instructor who has had enough practical experience, or is sufficiently posted, in sewerage and sewage-treatment work to point out to the student wherein, in places, current practice and views differ somewhat from those set forth in the text. For example, in discussing activated-sludge treatment the statement is made that the effluent from the aeration tank is run through a plain sedimentation tank, usually with a hopper bottom with a slope of about 60 deg. from the horizontal. Such a statement needs decided qualification, as tanks of the type mentioned are not used in the three largest and most recently built activated-sludge works in this country.

As the author evidenced a very sincere desire to meet the criticism of the first edition, the writer ventures the following as a few suggestions wherein the next edition can be improved. In giving references, always include the year of publication. If costs are to be given, give cost data that would be really useful. Thus, Table 69 gives the division of labor costs for the construction of a 96-in. circular concrete sewer. In the note at the bottom of the table it is stated that the trench was 12½ ft. wide and that at a depth of 12 ft. the cost of excavation was $1.61 per foot. With these data the excavation would be about 5.6 cu.yd. per linear foot of sewer and its cost 29c. per cubic yard. In the reference the year is not given. When looked up, it was found to be 1917. Further, the article did not state where the sewer was built. Such data, in the writer's opinion, are useless to the practicing engineer and misleading to the student. Excavation for such sewers, at least in these days, is not being taken out for 29c. per cubic yard or for anywhere near that amount.

Some of the illustrations might well be replaced by others. Thus it is unfortunate, in the writer's opinion, to continue to show, as an example of a contact bed, the Marion, Ohio, works, which have been abandoned and replaced by treatment works of an entirely different type. The cut of the Marion works is from the 1908 report of the Ohio State Board of Health. Again, sludge-drying beds as generally now built should be shown, rather than beds of the type shown in the book. The section on the construction of brick and segmental block sewers should be rewritten to accord with the best present-day practice. The same may be said of concrete sewers.

The third edition carries the statement that the Imhoff tank is patented in the United States and gives the royalties payable. The author has overlooked the fact that the basic Imhoff tank patents, in this country, expired several years ago.

In discussing separate sludge digestion, the author refers to sludge clarifiers and cites a Dorr sewage clarifier. The clarifier should be referred to as a sewage clarifier, not as a sludge clarifier, and should be treated under the subject of plain sedimentation rather than under separate sludge digestion. The sludge from a clarifier may go to a separate sludge digestion tank, and then again it may not. If the Dorr equipment is mentioned and illustrated, it would seem as if that made by the Link-Belt Company, called a sludge collector (of the drag scraper type), should also be mentioned and illustrated. Mention should be made of the so-called skimming-detritus tanks, such as are now in operation in Akron, Ohio, and under construction in Dayton, Ohio, and Chicago, Ill.

The book is well printed and bound and the cuts and drawings are well executed. A 13-p. index is included.

## A Veteran in Sanitary Journalism

THE STORY OF THE SANITARY ENGINEER, later the *Engineering Record*, Supplementary to Civil War Experiences—By Henry C. Meyer. New York: Privately Printed. Cloth; 6x9 in.; pp. 62.

Origins are significant. This small book, privately printed, gives the origin of the *Sanitary Engineer*, which later became the *Engineering Record* and now by consolidation with *Engineering News* has grown to the present *Engineering News-Record*. It records a most interesting chapter in the history of technical journalism.

Bad house-plumbing practice gave Henry C. Meyer the idea of starting a journal of sanitation, and now, "having passed my 84th birthday and having outlived most of my contemporaries," he tells how the idea originated and materialized. The telling is reminiscent rather than historical. It thus emphasizes the characteristics of an older period in journalism, when editors were propagandists more than purveyors of technical news and opinion. A gratifying degree of pride is shown all through the veteran editor's pages in the "reforms" and "movements" which he started or in which he took part—and let it be

testified here by editors of a younger generation that they were in many instances accomplishments which justify pride. This book of Mr. Meyer's is a little book, a brief casting up of recollections by one who looks far back in the life of engineering journalism, but it is well worth having been written.

## Design of Movable Dams

REVIEWED BY I. GUTMANN
*Associate Editor, Engineering Index, New York City*

DER EISENWASSERBAU—Von Professor Dr.-Ing. H. Kulka; Band 1: Theorie und Konstruktion der beweglichen Wehre. Berlin: Wilhelm Ernst & Sohn. Paper; 7x10 in.; pp. xii + 323; 383 line cuts and halftones. Paper, 29 marks; bound, 31 marks.

Professor Kulka's volume on the theory and design of movable dams is the first of a two-volume treatise on hydraulic steel structures. The volume which is to follow will be devoted to the design of lock gates, canal lifts, docks, canal bridges and similar structures using steel as the material of construction.

The present volume treats in a unique manner a subject which has been rather neglected by those who write for publication. In American hydraulic literature we have some sixty-odd pages in Wegmann's treatise on dams, and, to go back 30 years, B. F. Thomas' paper "Movable Dams" in the *Transactions* of the American Society of Civil Engineers, Vol. 39 (1898), pp. 431-572. In German we have a study by K. E. Hilgard (270 pp.) in the Franzius and Sonne series of engineering handbooks (Handbuch der Ingenieurenwissenschaften, 1912), not to mention a number of papers on individual structures. This is practically all the important writing on the subject as a whole.

To stress only the scarcity value of Professor Kulka's treatise would partake of the nature of an ungenerous compliment, for its merit is far greater and quite intrinsic. In its thoroughness and remarkable scientific approach it may unhesitatingly be held up as a model of engineering authorship. Unlike the works mentioned above, which are primarily descriptive discussions, this book presents an uncommonly harmonious system of general theoretical analysis applied to specific problems in practical design.

The book opens with a 40-p. mathematical introductory chapter on complex numbers, functions of complex variables, conformal graphical representation and potential functions. After this outline of the requisite mathematical equipment comes a chapter on hydromechanics (44 pp.), taking up pressure of water against cylindrical surfaces and treating both of the case of water at rest and of the case of water in motion. This chapter is not entirely theoretical, as it also contains an analytic account of special experiments on flow around roller weirs, instigated by the author and performed at the famous hydraulic laboratory of the Hanover Institute of Technology. The analysis of these experiments gives the author a fine opportunity to argue conformal representation versus the Cartesian system of rectilinear co-ordinates. It may be said here that with physicists this matter is past arguing; the superiority of curvilinear co-ordinates in the treatment of certain phenomena has been quite evident to them for some time and it is the turn of engineers now to learn what it is all about.

The remaining 240 pp. treat in detail of the design of wicket dams, Stoney gates, roller dams, collapsible weirs, sector dams, etc. Several European structures representative of each type are described and analyzed in detail. The author notes that the problems presented by these specific types of movable dams are treated as so many special cases of his general theory given in the first chapters of the book. In fact, he assures us that this general theory will take care of new types still unborn.

The book ends with a short chapter, contributed by C. Schiebler, of the General Electric Company of Germany (A.E.G.), on electric motors for intermittent operation of short duration and other equipment of electrically operated movable dams. There is no bibliographic list and no index to the book. Let us hope that we shall find them in the forthcoming second volume of this work.

The great majority of practicing engineers will no doubt balk at the theoretical part of the book. The wise alternative may be to take theory on faith and draw fully on the riches of its practical part.

## German Year Book for Sanitary Chemists

REVIEWED BY WILLEM RUDOLFS
*Chief, Department of Sewage Disposal, New Jersey Agricultural Experiment Station, New Brunswick, N. J.*

VOM WASSER—Ein Jahrbuch für Wasserchemie und Wasserreinigungstechnik. Herausgegeben von der Fachgruppe für Wasserchemie des Vereins Deutscher Chemiker. II Band 1928. Berlin: Chemie, G.m.b.H., Berlin W 10. Paper; 7x10 in.; pp. 280; illustrated, 14 marks in paper or 16 bound.

Twenty-six papers delivered before the 1928 convention of Sanitary Chemists held in Dresden. Papers on chlorination of water and sewage by Ornstein, Olsrewski, Merkel, Egger and Beseman give a comprehensive view of the results obtained and problems confronting the German chemists and engineers. Four papers on boiler-water treatment and chemical changes taking place are of considerable interest. Haupt gives a résumé of the progress of the work in America. There are two papers on sugar-beet waste treatment and one on laundry-waste disposal which are of special interest to those engaged in trade waste-disposal work. Sludge digestion and gas production are dealt with in two papers setting forth results obtained by Bach in Germany and Heilman in Halle. There are also papers on fish-pond and house-disposal systems, B. coli determinations, etc. The volume is valuable, especially since discussions of the papers are included.

## Fundamentals of City Planning

REVIEWED BY HAROLD M. LEWIS
*Executive Engineer, Regional Plan of New York and Its Environs*

GRUNDBEGRIFFE DES STÄDTEBAUES—Von K. A. Hoepfner, O. Professor on der Technischen Hochschule, Danzig. Zweiter Band. Berlin: Julius Springer. Paper; 7x10 in.; pp. 198. 120 line cuts and halftones. Paper, 14.5 marks; bound, 15.5 marks.

Professor Hoepfner's book might be called a research to determine the underlying essentials of city planning. It attempts to analyze the growth of the art of planning as now practiced and to determine what type of technician is best fitted to solve the problems involved. It is the second edition of a book first published in 1921. In this later edition the author has carried his researches farther back toward what he believes to be the true fundamentals of the problem.

The material is divided into two parts. The first of these deals with the types of problems and the methods of analysis necessary to solve them and shows why city planning is essentially a branch of engineering science.

The author states that a successful city planner must be fundamentally an engineer but must also be more than this and know much of other branches of science and of art.

The second part deals with the modern city-planning problem as contrasted with that of the past and contains illustrations and analyses of the patterns of early towns, starting with the German cities of the Middle Ages, continuing down through the seventeenth and eighteenth centuries (with several references to American cities), to end with a review of the development of planning problems of German cities in the nineteenth century.

The book is intended largely to guide those who wish to take up city planning as a profession and to show them what lines of research and study they should follow. The author admits that his work is largely theoretical but states that a correct theoretical groundwork is essential to the development of a practical city planner. The form of a city should be the true expression of its underlying purpose and function, and if planned from an analysis of these basic forces it will have beauty as well as efficiency.

## Publications Received

THE ILLINOIS WATERWAY and a number of recent buildings for hospitals, schools and other state institutions, including a circular cell-house at the new Stateville penitentiary, are described briefly and illustrated profusely in a 94-p. report of the Department of Purchases and Construction (Springfield, Ill.). Reference is made to progress in the standardization of plans for institutional buildings of the same class.

RAILWAY STATISTICS for the calendar year 1927 are published in a 274-p. volume by the Interstate Commerce Commission. A review of the financial and operating conditions for the year, accompanied by diagrams covering a term of years, occupies the first few pages, preceding the detailed and tabulated figures for the railway system and the individual railways. ($1.30 from Superintendent of Documents, Washington, D. C.)

CALIFORNIA SEWAGE-WORKS JOURNAL, the official publication of the recently organized California Sewage Works Association (E. A. Reinke, secretary-treasurer, Civil Engineering Building, Berkeley, Calif.), is supplied free to members, together with the *Journal* of the Federation of Sewage Works Associations. The price to non-members is $1 per number. The first issue contains, among other things, the proceedings of the first meeting of the association, at San Bernardino, Oct. 9 to 12; also a list of members.

STANDARD COMMERCIAL HEADGATES as water-measuring devices have proved satisfactory for the Fresno Irrigation District, Fresno, Calif., for individual and neighborhood ditches too small to justify the installation of the usual expensive measuring devices. A series of 1,100 tests using a standard make of headgate in sizes from 8 to 24 in. and with flows varying from 0.5 to 16 sec.-ft. is described in a bulletin which has just been issued by the district. As a result of these tests three standard installations for varying conditions were evolved, each of which, under similar circumstances, can be used to measure water flow within the limits of accuracy necessary in an irrigation system. The bulletin gives standard dimensions for these installations, as well as full tables for determining flow through each type.

TO MAKE MORE ACCESSIBLE the large number of technical specifications for materials and test methods which have been prepared by the committees of the American Society for Testing Materials, the society has just published an analytical and classified index to its various standards and tentative standards. The total number of these standards is 542, but the indexing has been carried so far that it forms a 95-p. pamphlet. In addition to subject index headings, such as Ceramics, Solder, or Porosity, it contains such entries as Impact, under which are listed the shatter test for coke, resistance to impact as contained in methods for testing insulating materials, tests for toughness of rock and tests for small, clear specimens of timber. The pamphlet is available without charge upon request to the society, at 1315 Spruce St., Philadelphia.

THE TESTIMONY AND EXHIBITS presented before the Interstate Commerce Commission in the proceedings relative to federal valuation of steam railroads, 1913-28, are contained in condensed form in a nineteen-volume digest recently completed. Ten volumes are devoted to investment accounts, six of these dealing with accounts which have been most in controversy. Eight volumes cover the inventory instructions and other matter, bringing the inventory and valuations to a common modern date. The nineteenth volume is a classified index of about 1,000 pages. This voluminous digest is not to be printed, since the demand would not warrant the expense, but the typewritten pages are arranged for blueprinting so that copies of the whole or of selected parts can be made by interested parties, for which purpose the original will be loaned. The digest is the work of L. D. McPherson, valuation attorney of the Wabash Railway, 1654 Railway Exchange Building, St. Louis, Mo.

PUBLIC HEALTH SURVEYS at New Haven, Conn., and Montreal, Que., are the subject of reports recently published. The New Haven survey was made under the auspices of the community by C.-E. A. Winslow, professor of public health, Yale School of Medicine, with various persons co-operating. Professor Winslow was connected with the Montreal survey also, as consultant on appraisal of the city health work, using the appraisal form of the American Public Health Association. The Montreal survey was made at the invitation of the Montreal Anti-Tuberculosis and General Health League under the general direction of "Business and Professional Citizens of Montreal" formed into a committee for the purpose. The Montreal report is published by the Metropolitan Life Insurance Company and may be secured from the League mentioned above. In each report various health and related activities of the city and of private organizations are reviewed. Health-activity ratings and also ratings under various subheads are given in each report in accordance with the appraisal form of the American Public Health Association. In the Montreal report it is stated that apparently only some 25 per cent of the typhoid cases for the five years 1923-27 were reported except during the epidemic of 1927. The New Haven report contains a table not only of the general death rate but also of the rates for various specific cases for the half-century ended 1926. The typhoid mortality in New Haven fell from 47 in 1877 to 2 in 1926, but it ranged from 51 to 64 in the early eighties, was 95 in 1901 and as late as 1906 was 51 per 100,000.

## New Books and Revised Editions

*[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]*

ANALYTIC MECHANICS—By Joseph B. Reynolds, Ph.D., Professor of Mathematics and Theoretical Mechanics, Lehigh University. New York: Prentice-Hall, Inc. Cloth; 6x9 in.; pp. 347; line cuts. $4.

Intended "primarily for students in technical schools and colleges." About 700 graded exercises, mostly original, are included. The same author has a book on Elementary Mechanics.

ARGUMENTS Reflecting Conditions in State and Municipal Ownership of Electric Utilities as presented by William J. Hagenah, Vice-President and Special Counsel, Byllesby Engineering & Management Corporation, before the Wisconsin Legislative Interim Committee on Water Powers at Madison, Wis., Nov. 26, 1928. Chicago: Byllesby Engineering & Management Corporation, 231 South La Salle St. Paper; 8½x11 in.; tables.

A brief for private ownership, with quotations and statistics.

AUDITORS' REPORTS AND WORKING PAPERS—By DeWitt Carl Eggleston, M.E., C.P.A., LL.B., Member of the firm of Klein, Hinds & Finke. New York and London: John Wiley & Sons. Cloth; 6x9 in.; pp. 305. $4.50 net.

BRITISH FLOODS AND DROUGHTS—By C. E. P. Brooks, D.Sc., Honorary Secretary, Royal Meteorological Society, and J. Glasspoole, M.Sc., Ph.D., Professional Associate, Institution of Water Engineers. London: Ernest Benn, Ltd. Cloth; 5½x8½ in.; pp. 199; 15 illustrations. 10½s.

CIVIL AIRPORTS AND AIRWAYS—By Archibald Black, Air Transport Engineer, with the collaboration of a group of nineteen specialists in the different angles of airport construction and equipment. New York and London: Simmons-Boardman Publishing Co. Cloth; 6x9 in.; pp. 238; 77 illustrations; maps and graphs. $5.

CONTROL OF FLOODS BY RESERVOIRS—By Paul Bailey. Appendix to Report to Legislature of 1927 on The Water Resources of California and a Co-ordinate Plan for Their Development. Sacramento: Division of Engineering and Irrigation, Department of Public Works. Paper; 6x9 in.; pp. 463; plates of diagrams, some folding and some in colors.

DAMPFTURBINEN: Berechnung und Konstruktion—Von Dr. Ing. Leonard Roth, Professor an der Hoheren Technischen Staatslehranstalt Nurnberg. Munchen and Berlin: R. Oldenbourg. Paper; 7x10 in.; pp. 103; 61 line cuts. 6 marks.

A short monograph on the calculation and design of the steam turbine.

DAMS AND CONTROL WORKS Constructed by the Bureau of Reclamation—Elwood Mead, Commissioner. Paper; 9x11½ in.; pp. 164; illustrated. From Government Printing Office, Washington, D. C.

Concise illustrated descriptions by various engineers.

DEFINITIONS OF TERMS Used in Sewerage and Sewage-Disposal Practice—Manuals of Engineering Practice, No. 2, Am.Soc.C.E. New York City: American Society of Civil Engineers. Paper; 6x9 in.; pp. 19.

Outgrowth of committee work initiated in 1915 by American Public Health Association and joined in later by American Society of Civil Engineers.

THE DUNBAR SEWAGE FILTER—By Prof. E. W. Steel, Director, and P. J. A. Zeller, Assistant Director, Sewage Research Division, Texas Engineering Experiment Station. Paper; 6x9 in.; pp. 13; illustrated. Free on application to Texas Engineering Experiment Station, F. E. Giesecke, Director, College Station, Tex.

Experimental studies of a filter of graded material, fine on top, named after Dr. Dunbar, of Hamburg, Germany.

THE ELEMENTS OF PRACTICAL MECHANICS—By Charles Ranald MacInnes, Ph.D., Professor of Mathematics in Princeton University. New York: D. Van Nostrand Co. Cloth; 6x9 in.; pp. 131; 146 line cuts. $2.25.

Intended "for use with classes of engineering students" who have a knowledge of Calculus and general Physics but little knowledge of Mechanics.

EXPERIMENTAL AND MATHEMATICAL ANALYSIS of Drain Tile Testing and New Test Bearing—By Dalton G. Miller, Senior Drainage Engineer, U. S. Dept. of Agriculture, in charge of co-operative drain tile laboratory, and Joseph A. Wise, Assistant Professor of Structural Engineering, Civil Engineering Department, University of Minnesota. Based on co-operative work of University of Minnesota Agricultural Experiment Station, State of Minnesota Department of Drainage and Waters, U. S. Department of Agriculture, and Bureau of Public Roads. Minneapolis: University of Minnesota. Paper; 6x9 in.; pp. 66; 30 line cuts.

FLOODS IN THE VALLEY OF THE MISSISSIPPI A NATIONAL CALAMITY: What Should Be Done About It—By J. P. Kemper, C.E., New Orleans: National Flood Commission, 1014 Chartres St. Cloth; 5½x8½; pp. 255; illustrated.

HANDBOOK OF HYDRAULICS for the Solution of Hydraulic Problems—By Horace Williams King, Member, American Society of Civil Engineers, Professor of Hydraulic Engineering, University of Michigan. Second Edition. New York and London: McGraw-Hill Book Co. Bound; 4½x7 in.; pp. 523; 143 line cuts and 129 tables. $4.

Recognition of advocacy in the first edition of the use of the Manning formula for open channels has led the author to recommend in this re-edition that the formula be used for pipes as well. A chapter "on critical depth and hydraulic pump" has been added, and new material on measuring flowing water and new tables. "The entire text has been rewritten."

HIGHWAY CONSTRUCTION, ADMINISTRATION AND FINANCE—By E. W. James, Chief, Division of Design, U. S. Bureau of Public Roads. Washington, D. C.: Highway Education Board. Paper; 6x9 in.; pp. 120; illustrated, mostly halftones. 50c.

INDUSTRIAL ADVERTISING COPY—By R. Bigelow Lockwood, Advertising Counselor, McGraw-Hill Publishing Company, Inc. First Edition. New York and London: McGraw-Hill Book Co. Cloth; 5½x8 in.; pp 328; 96 illustrations. $3.

Everyone who spends good money for advertising, either directly by paying or indirectly by helping incur the bills, as a "copywriter" will find this book valuable.

INTERMEDIATE HEAT—By R. A. Houstoun, M.A., D.Sc., Lecturer in Natural Philosophy in the University of Glasgow and Examiner in Physics in the Universities of Edinburgh and St. Andrews. New York, Toronto and London: Longmans, Green & Co. Cloth; 5½x8 in.; pp. 112; 68 illustrations. $1.25.

An elementary textbook similar in style to the author's Intermediate Light and Intermediate Electricity and Magnetism.

MATHEMATICAL TABLES AND FORMULAS—By Percey F. Smith, Ph.D., and William Raymond Longley, Ph.D., Professors of Mathematics in Yale University. New York and London: John Wiley & Sons. Bound; 5½x8 in.; pp. 66. $1.60 net.

Designed "primarily as a handbook" for freshmen and sophomores.

OPERATING COST STATISTICS OF AUTOMOBILES AND TRUCKS—By T. R. Agg, Highway Engineer, Iowa Engineering Experiment Station, and Harold S. Carter, Professor of Civil Engineering, South Dakota State College. Ames, Iowa: Iowa State College. Paper; 6x9 in.; pp. 51; illustrations and many tables. Free.

PROBLEME DE LA CANALISATION du Secteur des Cataractes du Bas-Danube. I: Evolution Recente des Transports et la Capacite de Trafic de la Voie Navigable—By Gregoire C. Vasilesco. Bucarest: Institut National Roumain; Flexible; 6x9 in.; pp. 142; illustrations and tables.

PROCEEDINGS. Punjab Engineering Congress, 1928. Labore: David A. Howell, Assoc. M. Inst. C.E., Honorary Business Manager. Paper; 6x9 in.; pp. about 170; halftones and line cuts, including folding plates.

THE PROFESSION OF ENGINEERING—Essays Edited by Dugald C. Jackson, Jr., S.M., Head of Department of Mechanical and Electrical Engineering, and W. Paul Jones, Ph.D., Assistant Professor of English, Speed Scientific School, University of Louisville. New York and London: John Wiley & Sons. Bound; 5x8 in.; pp. 124. $1.25.

Reprints of nine "essays," by seven men, "selected and arranged to form a unified whole" covering the main branches of engineering and, finally, touching on "the engineer's contribution to modern life." Designed as a textbook and for general reading. The authors are D. W. Mead, G. F. Swain, G. H. Barrus, R. Peele, H. W. Buck, J. H. Hammond and Herbert Clark Hoover.

PROVER MED MODELLTURBINER for Morkfoss-Solbergfossanlegget—Av Professor G. Sundby. Meddelelse fra Norges Tekniske Hoiskoles Vannkraftlaboratorium. Trondhjem: F. Bruns. Paper; 6x9 in.; pp. 80; 61 illustrations. $3.80.

SAN MATEO-SAN FRANCISCO SURVEY—Compiled by the San Francisco Bureau of Governmental Research for the San Francisco Chamber of Commerce. Paper; 8½x11 in.; pp. 196; illustrated.

A study of governmental agencies and public works leading to recommendations for consolidation of two counties that were once one.

SECONDA RELAZIONE Sull 'attivita dell' ufficio Speciale Irrigazione—Luglio, 1925 (IV)-Giugno, 1928 (VI)—Ente Autonomo per l'Acquedotto Pugliese. Bari: Gius. Laterza & Figli. Paper; 6½x10; pp. 201; illustrations, tables and folding plates.

SEWERAGE: The Designing, Constructing and Maintaining of Sewerage Systems and Sewage Treatment Plants—By A. Prescott Folwell, ScD., M.Am.Soc.C.E.; Past-President Am.Soc.Muni. Impts.; Editor, Public Works. Tenth Edition, rewritten and reset. New York and London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. 399; 121 halftones and line cuts.

STANDARDS YEARBOOK, 1929—Compiled by the National Bureau of Standards. Cloth; 6x9 in.; pp. 401. $1 from Superintendent of Documents, Washington, D. C.

STEENKOOL: Haar Ontstaan, Vervanging en Veredeling—Door J. J. Bootsgezel, Breskens Haurbour, Netherland. Deventer: A. E. Kluwer. Cloth; 8x11 in.; pp. 437; met 346 figuren en 2 uitslaande platen. F.13.50; Geb. f.15.

A treatise on coal and its conversion into gas, etc., written by the Inspector of Government Collieries of the Netherlands.

THE STORY OF EDDYSTONE—Philadelphia: The Baldwin Locomotive Works. Cloth: 8½x11½; pp. 75; many illustrations.

TECHNISCHE GESTEINKUNDE fur Bauingenieure, Kulturtechniker Land- und Forstwirte, sowie fur Steinbruchbesitzer und Steinbruchtechniker—Von Ing. Dr. phil. Josef Stiny, Professor an der Technischen Hochschule in Wien. Zweite, vermehrte und vollstandig umgearbeitete Auflage. Wien: Julius Springer. Cloth; 6x9 in.; pp. 550; 422 halftones and line cuts in the text. 45 marks.

TENTATIVE STANDARD SPECIFICATION for Reinforced-Concrete Culvert Pipe: Second Report of Joint Concrete Culvert Pipe Committee (M. W. Loving, Secretary, 33 West Grand Ave., Chicago, Ill.) Paper; 6x9 in.; pp. 15; line cuts and tables.

Principal changes over specifications of February, 1926, compared with 1926 specifications, are reduction in the amount of required circumferential reinforcement, a new load requirement for extra strength pipe, and the inclusion of an absorption test. Constituent organizations are A.S.T.M., U. S. Bureau of Public Roads, Am.Soc.C.E., Am. Asso. State Highway Officials, A.R.E.A., Am. Conc. Inst. and Am. Conc. Pipe Asso.

TESTS OF THE EFFECT OF BRACKETS in Reinforced-Concrete Rigid Frames—By Frank E. Richart, Structural Engineer Emergency Fleet Corporation. Research Paper No. 9, Reprint from the Bureau of Standards Journal of Research, August, 1928. Paper; 6x9 in.; pp. 65; illustrated. 25c. from Superintendent of Documents, Washington, D. C.

DIE THEORIE DER GEWICHTSSTAUMAUERN unter Rucksicht auf die neweren Ergebnisse der Festigkeitslehre—Von Dr. Ing. K. Kammüller, Privatdozent an der Technischen Hochschule in Karlsruhe. Berlin: Julius Springer. Paper; 5½x8½ in.; pp. 60; 25 line cuts. 5.4 marks.

TRACTIVE RESISTANCE OF AUTOMOBILES and Coefficients of Friction of Pneumatic Tires—By T. R. Agg, Highway Engineer, Iowa Engineering Experiment Station. In co-operation with U. S. Bureau of Public Roads. Paper; 6x9 in.; pp. 60; illustrated. Free.

TRANSACTIONS Eighth Annual Conference of State Sanitary Engineers—Public Health Bull. 183, U. S. Public Health Service. Paper; 6x9 in.; pp. 133. 25c. from Superintendent of Documents, Washington, D. C.

URBANIZATION: Its Effect on Government and Society—By John Giffen Thompson. New York: E. P. Dutton & Co. Cloth; 6x9 in.; pp. 683. $6.

WATER-BORNE COMMERCE OF THE UNITED STATES, Calendar Year 1927—Extract from Report of Chief of Engineers, U. S. Army, 1927-28. [Washington, D. C.] Paper; 6x9 in.; pp. 1,033.

WATER POWER OF CALIFORNIA, Report to Federal Power Commission—By Frank E. Bonner, District Engineer, U. S. Forest Service. Paper; 6x9 in.; pp. 206; folding and other maps (some maps in colors) and also cuts in text. 50c. from Superintendent of Documents, Washington, D. C.

WIDERSTANDSMESSUNGEN AN UMSTROMTEN ZYLINDERN Von Kreis- und Bruckenpfeilerquerschnitt—Von Dr.-Ing. F. Eisner, Regierungsbaumeister, Privatdozent an der Techn. Hochschule Berlin. Mitteilungen der Preussischen Versuchsanstalt fur Wasserbau und Schiffbau, Berlin. Berlin: Julius Springer. Paper; 8x11 in.; pp. 98; 63 line cuts and halftones. 10 marks.

# Letters to the Editor

## Licensed Drivers Reduce Accidents

Sir—It is gratifying to note that *Engineering News-Record* continues to emphasize the importance of traffic control, and it appears to me that in the brief space available in the editorial survey in your issue of Feb. 7 you have covered the ground well.

I regret, however, your apparent failure to recognize and emphasize the efficacy of the drivers' license law. It is not necessary to base the argument for this law on theory. The figures are convincing. While the number of street and highway fatalities for the country as a whole is constantly increasing, it is only in the North Atlantic states, all of which require operators to be licensed and all but one or two of which require new drivers to pass an examination before receiving a license, that the fatality rate from 1920 to 1927 inclusive has increased materially less than the number of motor vehicle registrations.

The figures are as follows: In the North Atlantic States, 76 per cent increase in fatalities, as against 176 per cent increase in motor vehicle registrations; for the Middle Western states, 134 per cent increase in fatalities, as against 137 per cent increase in registrations; for the Southern states, 259 per cent increase in fatalities, as against 210 per cent increase in registrations.

While it is undoubtedly true that these figures reflect other advances in traffic regulations in the several districts, other studies of the fatality records show decided improvements, ranging from 4 per cent to 32 per cent and averaging over 20 per cent, in individual states dating from their adoption of licensing laws.

A. B. BARBER,
Dorector, National Conference on Street and Highway Safety.

Washington, D. C.,
Feb. 19, 1929.

## Questions the 1:2 Sand Ratio

Sir—While there is much truth in Nathan C. Johnson's discussion of the relation of laboratory tests to field practice in connection with the preparation of concrete, the writer believes that the recommendations included in the "outline specifications" and in the discussion immediately preceding this specification, p. 267 of the Feb. 14, 1929, issue of *Engineering News-Record*, if generally adopted, will tend to lower the quality of field concrete.

Tests of aggregates available in the prairie provinces of Canada indicate that an aggregate grading of approximately equal parts fine and coarse, except for extremely fine sands, is best in compressive strength, low permeability and economy of cement. These aggregates include sands ranging in surface areas from 1,600 to 3,600 sq.in. per pound. The cement-sand ratio for such a combination of fine and coarse is about 1 : 3 for concrete of 2,000- to 2,500-lb. quality. The attempts to adhere to a 1 : 2 cement-sand ratio results in concretes which tend to segregate in the wetter consistencies, for the leaner mixtures, and which have lower compressive strengths for the same cement content per cubic yard. The permeability of these undersanded mixtures is also greater. Only the very rich oversanded concretes would have a sand-cement ratio as low as 2.

The writer believes that much of the defective concrete produced during the past twenty years has been due to the use of undersanded mixtures in an attempt to secure maximum density. Highest densities will usually be attained, for any given aggregate, by the use of a relatively low percentage of sand and a high percentage of coarse aggregate. The mortar content of such mixtures must be more fluid, owing to the greater quantity of coarse aggregate which must be floated and carried along, and this extra fluidity results in lower compressive strength, greater permeability and sometimes in honeycombing and segregation. Use of a greater proportion of fine and smaller proportion of coarse aggregate results in a less fluid mortar, although a greater total quantity of mixing water may be required in the batch, with higher strength values and less permeability. Adherence to Mr. Johnson's specification will tend to furnish similar undersanded concretes with their accompanying defects. Sand is the lowest-cost solid employed in the production of concrete, and its use up to the limits established by test will insure a better quality concrete at a lower cost.

In any case the writer believes that proportions should be based upon competent test data obtained with the materials at hand, rather than upon an arbitrary standard which may furnish an inferior concrete at a higher cost.

G. M. WILLIAMS,
University of Saskatchewan.

Saskatoon, Sask.,
March 4, 1929.

* * *

Sir—The doctrine advanced in the above letter appears to the writer to be on wholly new lines and out of accord with what seems to be fact.

Among other comments on the writer's article there was a proposal that the contractor receive a bonus for producing quality work. This is an unfortunate thought. In effect it is a proposal that the constructor shall receive a premium for doing simply what he agreed to do when the contract was signed.

In the writer's belief and experience, contractors as a guild do not ask either a mental allowance or an actual bonus for good work, but they do ask a specification for concrete that not only may produce good work under the severity of commercial procedures but also one that must and shall produce such work by its essence and through its interpretation of a thousand and one differentiated and isolated instances and localities.

The basic or general specification given in the article has proved that it meets these conditions. And this specification is not loose but is close-woven, though not inflexible. "As much stone as the mix will comfortably carry" rarely means as little as four parts of stone to a 1 : 2 mortar. If the stone is large, the proportion of stone may go to four parts, or possibly less, but inasmuch as experience is demonstrating the value and eventual economy of stone of approximately 1-in. maximum size, the proportion of stone called for is usually above four parts and may reach five or more parts.

Knuckle to knuckle on the stone, with enough mortar to fill up and bed between, gives about the ultimate in concrete for all definable values at present known.

NATHAN C. JOHNSON,
Consulting Engineer.

New York City,
March 18, 1929.

## Reinforced-Concrete Ties

Sir—I have noted with interest your article on "Steel and Concrete Ties" in *Engineering News-Record* of Feb. 28, together with the editorial on "The Substitute Tie" in the same issue. You refer to my tie as the "Casey" concrete tie. This is the "Brown" concrete crosstie and is designed, patented and distributed by the Concrete Tie Company, Pittsburgh, Pa. As you have noted, there is in excess of 25,000 ties now in service, and of this total our latest inspection shows a very small percentage of even hair cracks, while the percentage of ties actually fracturing, crushing, disintegrating or spalling is extremely low—in fact, negligible compared with the total number of ties in service.

Since the installation of the Brown concrete tie far exceeds in number any concrete tie installations previously attempted, we feel that this product should serve the long-felt want of more extensive actual roadbed tests. Although this installation is rather recent, the field inspections show that the ties are producing the desired results and further that they indicate the economic possibilities inherent in this product. We know that the extended life of this tie will prove an economic consideration far overbalancing the increased first cost over the price of the present wood ties, at the same time producing a heavier and more substantial roadbed, thereby producing both direct and indirect economies in the life and maintenance of rolling stock.

We also know from our experience, together with more than twenty years of practical railroad experience, that our present installations have supplied knowledge of practical and economical value. This tie is scientifically designed; calculations have been made and checked by prominent designers familiar with the use of reinforcing steel in concrete. The composition of the concrete was accurately determined and inspected during construction in accordance with the very latest methods of present-day construction. Since these ties

were installed we have been able to observe the effect on them from trainload impact under varying conditions, the ties being placed in cinder, gravel and stone ballast on curves and tangents and on grades and in freight and passenger tracks with the heaviest kind of traffic. The ties have held up remarkably well—in fact, beyond our expectations. It is true that some of the ties show hairline cracks in the center which are due to center binding. This will be overcome in the future by the addition of another reinforcing rod in the top and through the center of the tie.

You state in your article that these concrete ties upon inspection developed fractures, cracks, disintegration and spalling. I should appreciate greatly having your authority for this statement. Installations which have been made extend from a mile to 2 miles, according to their location, and those ties that have fractured, spalled or broken were damaged either in transit or in handling. In all the installations looked at I have found only one or two cases of this kind at each place. We agree that there is a wide field for the substitute concrete tie and we further feel that the results so far obtained by our present installations point to a wider use of this concrete crosstie.

Comparing the cost of the concrete tie with that of the wood tie and capitalizing the investment over a period of years designated as the minimum anticipated life of the concrete tie, it is plain that the economic aspect of the concrete tie is evidenced by its sound financial practicability. This concrete tie can be furnished at a cost less than twice the cost of a creosoted oak tie. Taking all these features into consideration, I believe a more encouraging statement could be made of our tie than what has gone forth to the public.

Pittsburgh, Pa.
March 7, 1929.

THE CONCRETE TIE COMPANY,
N. F. Brown, President.

[In the statements of the Pennsylvania Railroad included in the 1927 and 1928 reports of the tie committee of the American Railway Engineering Association the ties in question are designated as the Casey ties, but in the 1929 report they are designated as the Brown ties, "also referred to as Casey ties." Failures noted in the article mentioned are given in greater detail in this last report of the committee. It is stated that of the 510 ties originally installed, in 1925, "46 have been replaced on account of breakages." The report states that the installation of about 25,000 ties of improved design in 1927 and 1928 is "the most elaborate and impressive test of reinforced-concrete ties that has ever been made by any railway in America." But it will be seen that after two years' experience with the original design, the design was improved, as mentioned above, and future modification of the present design is mentioned by Mr. Brown. The point is that these ties have not had service enough to warrant definite conclusions as yet, either as to their design or their life. EDITOR.]

## *Absorption of Wood Preservatives*

Sir—J. D. MacLean's article in the Jan. 31, 1929, issue of the *Engineering News-Record* on "Absorption of Wood Preservatives" is one which should receive careful consideration by all parties interested in wood preservatives, especially the buyers and their inspectors and engineers.

The American Wood Preservers' Association, backed up by some of the government departments, has secured practically nation-wide acceptance of the method of specifying wood preservatives based on the number of pounds of preservative per cubic foot of lumber. In addition it has made certain recommendations based on such specifications which have been generally accepted as both desirable and practical. The recommendations vary the amount of oil per cubic foot of lumber based, first, on the kind of timber used, one recommendation for Douglas fir and another for all other kinds; second, on the use to which the timber is to be put, and third, on the size, grouping all timber 5 in. or more in thickness and all timber less than 5 in. thick. Some of these recommendations are almost impossible of attainment and Table I of the article, though intended to show the fallacies in the recognized method of specifying preservative treatment, brings this fact out clearly.

For instance, the American Wood Preservers' Association recommends for structural timber (Douglas fir) 5 in. or more in thickness, 12 lb. of oil per cubic foot by the full-cell pressure process. Table I indicates that Southern pine caps 10x12x22 ft. long require, to secure this weight of oil, an approximate depth of side penetration, assuming air space in treated portion completely filled, of 0.95 in. With Douglas fir this penetration should be slightly greater, but forgetting this factor, how many preservative plants would guarantee an average penetration of 0.95 in.? Few if any, but almost all would guarantee 12 lb. of oil per cubic foot of lumber. Further, with an inspector right on the job the gages would invariably show a quantity of oil used sufficient to provide the 12 lb. of oil per cubic foot, but borings would rarely show more than a $\frac{1}{8}$-in. penetration.

Mr. MacLean presents the problem admirably, but his remedies, in addition to solving only part of the problem, are quite cumbersome, especially where a charge is made up of timbers of varying sizes and lengths. Why not discard the entire method of specifying quantity of oil per cubic foot of timber and specify, instead, the minimum or average side penetration, which penetration shall vary with the kind of lumber, greater for Southern pine and less for Douglas fir, and, with the portion of the particular stick, greater for sapwood and less for heartwood?

For instance, it might be specified that Southern pine timbers treated by the full-cell pressure process shall have complete penetration through the sapwood and a minimum of $\frac{1}{2}$-in. side penetration through the heartwood and that all impregnated portions of the timber shall be thoroughly toxic. No elaborate tables for the various sizes of timber would be necessary and no rigid inspection of the many hours of treatment would be required. The plant operators would use their best judgment as to how to obtain the desired result, and when the treatment was over the inspectors would take side borings of representative samples. This is easily done with a Swedish increment borer, a simple, compact instrument which extracts a small core of any reasonable length. If the penetration was as specified and the portion penetrated thoroughly toxic, the batch would be accepted. If not, it would be rejected.

If some such method were generally adopted so that the buyer could be sure of securing what he believed he had bought, much needed confidence in the wood-preservative field would be restored.

J. BARNETT,
Chief Draftsman,
Engineering Design Division,
Westchester County Park Commission.

Bronxville, N. Y.
March 6, 1929.

## *Drowned Concrete*

Sir—When, several months ago, the sodden, swollen, lifeless body of a man was found floating in the waters of Puget Sound, without bullet wounds, bruises, contusions or other evidence of violence upon it, it was decided that the man had been drowned.

When, a few weeks ago, for no apparent reason, a man leaped from a Lake Washington ferry boat and disappeared beneath the waters, not to be seen again, it likewise was decided that he was drowned. A psycho-analyst might have contributed some impressive thoughts on the obscure causes and vagaries of human behavior, but could not alter the fact that the man was drowned.

After the many centuries of accumulated human experience, death by drowning is recognized, admitted, believed. If a man is drowned, he is drowned, and that is all there is to it.

But in the case of dead or well-nigh lifeless concrete, discolored with great blotches of damp efflorescence, porous, leaky, full of gravel pockets, aggregate segregations, laitance streaks and layers, spallings and crumblings and other symptoms and manifestations, what a time we have in deciding what is wrong, instead of saying, shortly and briefly, "drowned." We speculate on possible causes; we wonder if brick veneers might not have made things different; we are troubled and puzzled and shake our heads seriously.

The writer truly believes that there cannot be too much research and investigation of things concrete; that there has been too much conventional specifying and too much use of what Mr. Johnson so happily calls "a mere headquarters formula." But also he believes that it would be a great advance in engineering to recognize that drowning is responsible for most of the concrete mortality.

Your very fine issue of Jan. 24 is responsible for this letter.

W. F. WAY.

Seattle, Wash.,
Feb. 7, 1929.

# News of the Week

## Sanitary Commission Is Proposed in Bill For New York City

### New Department Would Take Over Street Cleaning, Water Service and Sewage Disposal

CONSOLIDATION of the entire street cleaning, sewage and waste disposal services of New York City, now distributed among various agencies, is proposed by a bill before the New York Legislature amending the charter of Greater New York. At present sewerage in all five boroughs, as well as street cleaning and the collection and disposal of garbage, ashes and miscellaneous dry wastes in Queens and Richmond boroughs, are under the several Borough Presidents, while the New York Street Cleaning Department functions in Manhattan, Brooklyn and Bronx boroughs only. The consolidation would still leave to the Borough Presidents the sewerage systems within their boroughs, excluding outlets to disposal works and those works themselves, except that the location of all sewer outlets (points of final discharge) would be subject to agreement between the borough officer in charge of construction and the proposed Sanitary Commission. In case of failure to agree, the Board of Estimate and Apportionment (the real governing body of New York City) would be arbitrator. No construction contract for a new outlet could be let until its location had been determined.

#### To Consist of Three Members

The proposed Sanitary Commission would consist of three members, appointed by the Mayor and subject to removal by him on charges. They would serve for terms of six years and would receive salaries to be fixed according to the present charter. One of the members, the bill states, "shall be experienced in matters relating to public health" and one "shall be experienced in sanitary engineering." No qualification for the third member is specified. The Mayor would designate one of the members as chairman of the commission.

The department would have three divisions: (1) administration; (2) street cleaning and waste disposal; (3) intercepting sewers and sewage disposal. The division of administration would be headed by the chairman of the commission or a person designated by him. The two other divisions would be headed by either a member of the commission or an officer of the department designated by the commission. Initially the "organization of the [present] department of street cleaning" would be "continued as the division of street cleaning and waste disposal," while the head of the division of intercepting sewers and waste disposal, with the approval of the commission, would be empowered to take over members of the sewer bureaus of the various boroughs. The bill makes the chairman of the commission the chief executive officer of the department. He would have charge, among other things, "of the appointment and removal of all officers and employees of the department." The commission would have power to appoint and remove a secretary of the department and "employ such experts, engineers, chemists and other employees as may be lawfully provided."

Besides jurisdiction over street cleaning, ice and snow removal, the removal and disposal of ashes, street sweepings, garbage, refuse, rubbish and dead animals, the commission would control the operation of the disposal of all these wastes and of sewage, with power to locate and construct disposal plants and "intercepting sewers to connect" with sewage-works.

## Van Norman Heads Joint Water and Power Bureau at Los Angeles

H. A. Van Norman, who last December succeeded William Mulholland as head of the Los Angeles Bureau of Water Works and Supply, on March 12 was made chief engineer and general manager of a newly created Department of Water and Power. This move was made to bring under unified control and administration both the water and the power bureaus, heretofore separate organizations. Under Mr. Van Norman's direction E. F. Scattergood will serve as chief electrical engineer, and F. E. Weymouth, who was Mr. Van Norman's assistant, becomes chief hydraulic engineer. Abolition of the old bureaus and creation of the new department, according to the announcement of the Board of Water Commissioners, by which body the change was made, is to centralize control, eliminate duplication and increase efficiency. Staffs of the two former bureaus will be consolidated into one flexible staff to be used when, where and as needed under the direction of one head. Mr. Van Norman's 22 years of service with the city's water department was reviewed in *Engineering News-Record*, Dec. 6, 1928, p. 855.

*Murillo Photo.*

## Floods Reach Record Heights in Southern Georgia and Alabama

### Mississippi River High, but Is Not Expected to Rise Much—Levees Now Stronger Than in 1927

FLOODS in Georgia and Alabama appear to have reached their crests except in the lower valleys of some of the rivers. On the Mississippi flood stages are common but no abnormally high water is expected. Damage to dwellings in Alabama and Georgia has been large, but engineering structures other than highways or railways on embankments have not suffered badly.

Reporting conditions in Georgia, Searcy B. Slack, bridge engineer of the state highway department, telegraphs as follows: Flood damage heavy, rain March 12 to 15 amounts to from 4 to as much as 11 inches in some sections. Chattahoochee and Flint rivers making new high water records in many places. One bent of concrete approach trestle of the Flint River bridge at Montezuma undermined and has settled damaging 70 ft. of the bridge. No other damage to major bridges reported so far, but crest has not reached lower section of the state. Damage in southwestern section state probably more than previous two floods this month and about same in other sections. Suggest your paper advocate legislation against three major floods in one state in one month.

#### Conditions in Alabama

Conditions in Alabama are reported by telegraph by Herman Orr for the director of highways as follows: Water from 1 to 12 ft. higher than previous records. Three weeks rain had raised streams to flood stage when cloudburst occurred causing sudden extreme rise. Wood frame structures badly damaged and brick structures damaged but standing in blocks with end walls blown out by current. Properly constructed bridges of concrete, steel or timber standing after being as much as 15 ft. under water; some abutments and footings undermined. Many highway and railway embankments swept out and the paving and track destroyed. Normal highway traffic maintained by temporary construction as water recedes. Probably several weeks before traffic normal on railroads. Airplanes and radio great help.

#### Mississippi High Water

Unless unforeseen rains add local floods to high water in the lower Mississippi Valley abnormal floods are not anticipated there. After consultation with the district engineers at Vicksburg and New Orleans, H. W. Richardson of

the staff of *Engineering News-Record* telegraphs that hydrographs show the main river practically at the same stage today as on corresponding date in 1927 except somewhat lower at New Orleans and on most of the tributaries. Cairo gage now 51 with little further rise predicted. Arkansas City gage now 48.2 with crest of 53 predicted. Vicksburg gage now 43.3 with 50 predicted. New Orleans gage now 13.2; predict 17. Predicted crests will cause no serious trouble, but there is possibility of sudden floods on tributaries synchronized with main river crests causing conditions similar to 1927. Major John Lee declares levee system in much better shape than two years ago and capable of withstanding flood of 1922 magnitude but of course would give way if 1927 stages reached. Reservoir capacity of lower river and fair weather past few days on upper river encouraging. No trouble yet on main river except at Hickman, Ky. Army engineers cooperating with levee boards organizing through patrol system effective at once as precautionary measure. Crests expected early in April.

## Lectures on Hydraulic Subjects to Be Given by Dr. Rehbock

Beginning on March 21 Dr. Theodor Rehbock, professor of hydraulics at the Technische Hochschule of Karlsruhe, Germany, will deliver a series of lectures at the department of civil engineering of Massachusetts Institute of Technology, Cambridge. The lectures will be continued on March 22, 26, 27, 29 and April 2, 3, 5 and 9, at 2 o'clock each afternoon. Among the subjects to be treated are the measurement of water, model experimentation, laws of similarity, river flow, laboratory work at Karlsruhe and rules for laboratory construction and procedure. The lectures will be illustrated with moving and still pictures.

Dr. Rehbock is one of the leading hydraulic engineers of Germany. Upon his arrival in this country a luncheon in his honor was given at the Engineers Club, New York, by the president and members of the board of directors and past officers of the four founder societies and the United Engineering Societies.

Welcome was extended to him in behalf of the American engineering profession by John R. Freeman, past-president of the American Society of Civil Engineers and of the American Society of Mechanical Engineers, who presided, and by Clemens Herschel, Gustav Lindenthal, Allen Hazen and Calvin W. Rice, secretary of the American Society of Mechanical Engineers. A tribute to the guest of honor was received by letter from Prof. Charles D. Marx, of Stanford University.

# Detroit Has Bids on Two Pipe Materials and 4 Joint Types

### Evaluation Shows Only a Negligible Difference Between Steel and Armco Ingot Iron

ON AN "evaluated" basis there was no substantial difference between steel and Armco ingot iron as material for nearly 5 miles of large water mains in the tender of the lowest bidder for the material in place received by the Water Board of Detroit, Mich., on March 13. The proposals called for 24,050 ft. of 72-in. and 250 ft. of 60-in. pipe, all from ½-in. plates, the longitudinal joints to be of lock-bar, hammer-weld, electrically riveted or ordinary riveted type. A relatively small amount of accessory work is included, totaling about $60,000, according to the lowest bidder.

There were three bidders. The lowest bidder, the J. A. Mercier Brandon Company, Detroit, bid $606,159 for steel pipe, either electrically welded or riveted, and $688,919 for Armco iron pipe, electrically welded. Applying the evaluation factors to these bids, the steel pipe stands $964,484 and the Armco iron $964,945. The evaluation factors are thus described in the specifications:

> The total bid price quoted for all items of the contract for each type of pipe proposed to be used should be multiplied by 1.734, which represents the total payment required to pay interest and sinking fund charges on each dollar of 30-year 4 per cent bonds. From the products obtained by the above multiplications there shall be deducted, for all cases where the use of steel pipe is contemplated, one-seventh the total prices quoted and for all cases where the use of Armco pipe is contemplated, one-third the total prices quoted. The amounts remaining after the subtractions have been made shall become the evaluated bids to be used for comparison.

Unit prices for 72-in. pipe in the lowest bids were $22.66 for either welded longitudinal-joint or for riveted steel and $26.06 for electrically welded Armco ingot iron pipe. The only bid (by another bidder) on lock-bar joint steel was $27 per foot. The same bidder offered lock-bar Armco for $35 and riveted Armco for $30, his being the only bids on these types of Armco. There was no bid on hammer-welded pipe, either steel or Armco iron. Detailed bids will be given next week in the Construction News Section of *Engineering News-Record*.

Evaluated bids offered by the three bidders were:

| | J. A. Mercier Brandon Co., Detroit | Mark R. Hanna Co., Detroit | R. D. Baker, Royal Oak, Mich. |
|---|---|---|---|
| Lock-bar steel pipe | ..... | 1,132,376.59 | ..... |
| Electrically welded steel pipe | 964,484.77 | 987,085.37 | 977,244.15 |
| Riveted steel pipe | 964,484.77 | 1,054,251.62 | ..... |
| Lock-bar Armco iron pipe | ..... | 1,269,109.05 | ..... |
| Electrically welded Armco iron pipe | 964,945.18 | 1,008,224.39 | 982,788.28 |
| Riveted Armco iron pipe | ..... | 1,098,227.72 | ..... |
| Time in days | 225 | 200 | No time |

George H. Fenkell is general manager and engineer of the Detroit Water Board; D. C. Grobbel, acting secretary; F. H. Stephenson, engineer of water system.

## Nineteen Past-Presidents Attend N.E.W.W.A. Luncheon Meeting

"Past-Presidents Day" was the feature of the luncheon meeting of the New England Water Works Association held March 13 at Boston. Of the 22 living past-presidents, nineteen were present to participate in the presentation of certificates of honorary membership to the following members: Harry W. Clark, director and chief chemist, Massachusetts Department of Public Health, Boston; Harrison P. Eddy, of Metcalf & Eddy, consulting engineers, Boston; Frank A. McInnes, consulting engineer, Boston; Caleb M. Saville, manager and chief engineer, Board of Water Commissioners, Hartford, Conn.

Commissioner Waddell, of the State Department of Finance, spoke upon the desirability of legislation to insure the general use of water revenue for water department purposes only, based upon adequate and proper rates. The officers of the association are to work with Mr. Waddell to advance such legislation.

Albert C. Dickerman, former superintendent of the East Providence Water Company, presented an interesting paper outlining the many difficulties encountered in framing water rates in this community—particularly charges for fire protection service—leading up to the final taking over of the property of the company by the town, in 1928.

## Engineer Made Executive Assistant in Interior Department

Ernest Walker Sawyer has been appointed by Secretary Wilbur, of the Department of the Interior, as executive assistant in his immediate office. Mr. Sawyer is an engineer and will assist the Secretary particularly in the engineering problems of the department. Mr. Sawyer is 43 years old and was graduated from the Geneseo Collegiate Institute of Illinois in 1904 and from the civil engineering department of Stanford University in 1909. After engaging in railroad work in this country, Canada and Mexico he became construction engineer for the Federal Telegraph Company, of San Francisco. In 1912 he constructed a radio station at Newcastle, N. B., which he afterward operated for the Canadian government. Later Mr. Sawyer went into the manufacture of radio equipment in London, and furnished the radio equipment for many of the large stations of Europe, including that on the Eiffel Tower. He returned to New York in 1920 and became consulting engineer of the All-American Cables & Postal Telegraph Company. In 1923 he established a radio company in New York.

# N. Y. Road Builders Aiming at Higher Business Standards

### State Chapter of A.G.C. Takes the Initiative in Effort to Improve Conditions

EVIDENCE of a concerted effort to establish highway construction in New York State upon a sound business basis was supplied March 13 and 14 at the third annual convention, in Syracuse, of the New York State Highway Chapter of the Associated General Contractors of America. Under the leadership of President E. P. Forrestel, of the Cold Springs Construction Company, Buffalo, the chapter has taken the initiative in enlisting the co-operation of other agencies of the highway industry in the state, with the aim of improving conditions affecting the construction of highways, the bonding of contractors, the credit terms involved in the sale of equipment and materials, and bidding by irresponsible individuals.

#### Specification Changes

At the opening session recent changes in New York State highway contracts and specifications were reviewed by Louis Mayersohn, of Albany, vice-president of the chapter. Of decided benefit to contractors is the new regulation providing for semi-monthly instead of monthly payments on estimates of $30,000 or more. Another change allows the delivery of cement in five-ply paper bags, as well as in cloth sacks. Cement, however, must be brought to the mixer in bags, instead of loose in the batch boxes with the sand and stone. This provision, it is predicted, will increase costs and result in a greater loss of cement sacks. In the new specifications no allowance is made for overhaul in earth handling. Another change eliminates the former 5 per cent allowance for overrun in steel reinforcing bars. There have been introduced optional specifications for bituminous top courses —either a 2-in. mixed or a 3-in. penetration course. Finishing machines for concrete paving slabs are now compulsory. The item "excavation" is still unclassified as to character of material, a provision the contractors object to on account of its non-discrimination between earth and rock. The new specification clause allowing use of quick-setting cement is regarded with favor. Under present conditions contractors are not compensated for maintaining traffic between construction barricades. A new field operation is required in the form of a painted traffic guide line along the longitudinal center-line joint.

#### Construction

Co-ordinating construction operations to reduce lost time was the theme of a paper by William A. Blanchette, of the U. S. Bureau of Public Roads, who presented the results of field studies by members of that organization.

Charles R. Waters, district engineer at Buffalo for the state highway department, made a number of constructive suggestions in a paper "Observations of a District Engineer." He urged tighter credit policies for the sale of equipment and materials, indorsed the principle of prequalification for both contractors and sub-contractors, and pointed to the need of fair treatment for the responsible sub-contractor. Mr. Waters described in detail an extensive program of salvaging old concrete pavements with bituminous tops and of building new pavements in two courses, a type of construction for which many advantages are claimed. Chief of these is a reduction of surface scaling. More accurate devices for the measurement of water for the concrete mix were referred to as an urgent present-day need. Sprayed asphaltic emulsions as substitutes for sprinkling with water hold attractive possibilities in the curing of concrete slabs, according to Mr. Waters.

In discussion W. L. Collins, contractor, of Hornell, stressed the desirability of having contractors, as advisers on practical construction detail, participate in the drafting of highway specifications.

A. H. Hunter, engineer of the Illinois Association of Highway and Municipal Contractors, Chicago, contributed valuable detailed figures on highway construction costs. He showed the effect, in lowered unit costs, of increasing the average daily rate of construction.

#### Bonding

Representing the Associated General Contractors of America, S. M. Williams made a strong plea for placing construction on a higher business plane and correcting abuses that have been undermining the industry. The need for decisive action, he pointed out, is seen in a recent analysis of contractors' income tax returns, showing, for 16,770 statements filed, an average net profit of only 3.2 per cent. A step forward in improving bonding conditions, Mr. Williams announced, is the recent formation of the surety division of the A.G.C., comprising 22 companies doing more than 80 per cent of the nation's total construction bonding business. Other fronts on which the A.G.C. is carrying on its attack include the irresponsible bidder and the equipment manufacturer or distributor with loose credit policies.

New officers elected for the current year are: President, Louis Mayersohn, Albany; vice-president, John H. Bolton, Watkins Glen; secretary-treasurer, Richard Hopkins, Albany.

## To Build Roadway on Railroad Bridge at Quebec

Arrangements are reported to have been concluded whereby the Quebec government will spend $400,000 in constructing a vehicular roadway across the Quebec railway bridge spanning the St. Lawrence River above the city of Quebec. It will be the only roadway over the St. Lawrence below Montreal and will link the provincial highways north and south of the river.

## Work to Start on Water Tunnel Following Court Decision

A decision in favor of the city of New York by the New York State Court of Appeals on March 20 in the suit brought to invalidate the award of a contract for four sections of the city's new water tunnel will make it possible now to proceed with that work. Only preliminary work has been done since the contract was awarded in October. The suit was to restrain the city from awarding the contract for all four sections of the tunnel to Patrick McGovern, Inc., for $42,692,567, the low bidder on two sections and whose bid for the four sections was only $14,373 in excess of the combined low bids for all four sections. The Board of Water Supply, using its discretionary powers permitted by law, declared the low bidder on one section unqualified. This left the combined McGovern bid low by more than $600,000. Details of the award and of the suit were given in *Engineering News-Record*, Oct. 11, 1928, p. 562; Oct. 25, p. 634; Nov. 15, p. 749, and Nov. 22, 1928, p. 785.

## Contract Awarded for Denver's City and County Building

The contract for the construction of the new city and county building at Denver, Colo., has been awarded to Varnum & Bates, local contractors, with whom is associated the Fleisher Engineering & Construction Company, of Chicago. The cost of the building will be between $4,000,000 and $6,000,000. The work, which has been delayed several years, is expected to begin by the first of April.

## George C. Mason Dies

George C. Mason, for many years vice-president and chief engineer of the Hurley-Mason Company, Portland, Ore., died in that city on March 10. Mr. Mason was born in New York City in 1871 and graduated from New York University in 1892, subsequently receiving the degrees of C.E. and M.S. from the same institution, where he served for a time as assistant professor of civil engineering. In 1904 he assisted in the organization of the Hurley-Mason Company to carry out construction work on the Pacific Coast, with offices at Tacoma, Seattle, Spokane and Portland, making his home at Portland and taking an active part in its civil life. For five years he served as a member of the city's Civil Service Commission. During the war his firm built the army cantonment at Camp Lewis and the Todd Drydock & Shipbuilding Company's plant at Tacoma.

From 1923 to 1925 Mr. Mason served as a director of the American Society of Civil Engineers. Since the closing of the Portland office of the Hurley-Mason Company in 1927 Mr. Mason had practiced as a consulting engineer in that city.

# WASHINGTON NOTES

By Paul Wooton
*Washington Correspondent*

## Needle Dam Decided Best Type for Intake of Bonnet Carré Spillway—Interocean Canal Routes Studied

A NEEDLE DAM has been decided upon by the army engineers as the best type of construction for use at the intake of the Bonnet Carré spillway which is to connect the Mississippi River with Lake Pontchartrain above New Orleans. The needle dam was decided upon because it eliminates dependence upon machinery that may have stood idle for five years and the possibilities of difficulties that might arise through settlement or the presence of drift in the river. As planned at Bonnet Carré, more than two-thirds of the load would be borne by the sill and distributed through the whole mass of ground. This is regarded as a great advantage because of the lack of stability of the soil at the point where the work must be built. Another reason which influenced the engineers in their decision was the fact that an emergency may arise which requires the very prompt opening of the spillway. In the structure they are designing the only machinery required would be hand winches and if necessary the vertical members could be removed by hand. More than 14,000 6x6 timbers will be used.

The army engineers were influenced to use this type of construction by their experience at other points where conditions are similar, and particularly on the Ouachita River, where the soil is even more unstable than at Bonnet Carré.

Tests and borings now are being made to determine the length of the steel sheetpiling of which a cutoff near the river will be constructed. Indications are that 60-ft. lengths will be used. For conditions as they exist at Bonnet Carré it is believed that the advantages of wooden piles outweigh those of concrete piles. It will be necessary to support all of the concrete apron on piling.

Because of the large number of protests that have come from the lower Mississippi River, the Mississippi River Commission, on its semi-annual trip which begins April 22, will pay particular attention to levee location. In moving back the levees to new locations valuable land is sacrificed, which gives rise to the protests. Particular attention also is to be given the area which will be unprotected from backwater and to the problems of handling drainage.

### Studying Interocean Canal Routes

Locations previously considered for an interocean canal, including one involving a tunnel under the continental divide in Panama, are being studied again as the Corps of Engineers is completing its plans for a resurvey of the Nicaraguan Canal route. Amendments were added to the Congressional resolution ordering a resurvey of the Nicaraguan route, the effect of which are to broaden the scope of the work to include a study of any other practicable route.

Since members of Congress have laid emphasis on the desirability of a sea level canal, it is a virtual certainty that the route formerly proposed at San Blas, the plans of which call for a tunnel, will receive serious consideration. The army engineers point out that a canal at this location would be 15 miles shorter than the Panama Canal and would cost no more to construct than it would to dig a lock canal across Nicaragua. San Blas Point is situated on the Caribbean about 40 miles south of the Panama Canal.

After passing under the continental divide, the San Blas canal would follow the Rio Carti and the Chepo River to the Pacific. Because of the difference between the tidal heights of the Atlantic and the Pacific, tidal locks would be required.

The army engineers have been puzzled at the opinion prevailing in Congress that the canal under consideration across Nicaragua would be a sea level route. They point out that Lake Nicaragua, across which 70 miles of the route would lie, is 110 ft. above sea level. As a lock canal, the Nicaraguan route would be superior to the Panama Canal, mainly because there is a greater supply of water for the locks. The army engineers state, however, that the Panama Canal can be transformed into a sea level canal without interrupting traffic, at an estimated cost of $1,000,000,000.

## New York Votes $156,000,000 Public Improvement Program

The Board of Estimate and Apportionment of New York City formally ratified on March 15 a $156,000,000 program of public city improvements for the ensuing fiscal year.

This program includes large sums for new bridges, ferries, hospitals, park improvements, schools, subway construction, the tri-borough bridge, and the vehicular tunnel between Brooklyn and Staten Island. All these projects are to be financed by means of corporate stock, serial bonds and tax notes.

Embodied in the program is $75,000,000 for subway construction; $46,000,000 for the Board of Education, to be used largely for new school buildings; $10,000,000 for bridge improvements and new ferryboats, and $750,000 to meet a bequest of a like sum by the late Harry Payne Whitney for the building of a new wing on the American Museum of Natural History.

## Ice Jam Carries Away Bridge

An ice jam, carried by high waters of the Wind River, has washed away the Wind River bridge on the state highway east of Shoshone, Wyo. The ice cut away the under piling of the bridge and the 1,000 ft. of trestle was carried away. Construction of a new bridge costing $100,000 over the river at this point is included in the state highway program for 1929.

## Power Scheme on St. Lawrence River Approved

A protracted contest between rival power interests has been terminated by the Canadian government in granting the application of the Beauharnois Light, Heat & Power Company for permission to construct a power canal between Lakes St. Francis and St. Louis on the St. Lawrence River. The scheme will involve the diversion of 40,000 sec.-ft. and will enable the company to proceed with the initial power development of 500,000 hp. It is estimated that the proposed development will cost approximately $65,000,000.

In June last the company obtained a lease of the site from the Quebec government, but the consent of the federal government was necessary, as the matter is one that affects navigation. This phase of the proposal was investigated by a committee of government engineers, who reported that if the work were constructed in accordance with plans and specifications which they laid down it would not impede or interfere with navigation and the canal could be made a part of the deep-water development on the St. Lawrence.

The most important of the conditions attached to the granting of the application is the provision that should the dominion authorities at any future time desire to use the canal as part of the St. Lawrence shipway it shall become the property of the people of Canada free of cost. It has to be constructed according to specifications which make it suitable for oceangoing steamers, and must be 600 ft. wide at the bottom by 27 ft. in depth at low stage, and have a rate of flow not exceeding 2¼ ft. per second.

Should the disputed question as to power rights between the federal and provincial governments be decided in favor of the former, the company will have to pay the dominion a yearly rental. The Department of Public Works will control the construction from an engineering standpoint, and should the St. Lawrence waterways project go through the company will be called upon to construct certain aids to navigation in addition to the canal and it must do nothing that will interfere with treaty operations between Canada and the United States.

## City of Albany Has $7,500,000 Construction Program

The city of Albany is planning to carry out this year a major construction program amounting to approximately $7,500,000.

Projects included are: additional work on a new water-supply system, estimated to cost $5,300,000; a new junior high school to cost $1,000,000, and a separate sewer system in the Thirteenth Ward to cost $150,000. Only work expected to be placed under contract this year is included in this list. Contracts started last year and still uncompleted are not included.

### Federal Road Engineer Loaned to Colombia

Edwin W. James, chief of the division of design of the U. S. Bureau of Public Roads, has been appointed by the government of Colombia to serve as a member of a commission to study and prepare plans for the improvement of the system of transportation and communication in that country. The commission will consist of five members, three of whom will be foreign engineers, selected as expert advisers on highway, railway and waterway transportation. Mr. James has been appointed as the highway expert.

The request for Mr. James' services follows widespread interest in South America and Central America aroused by repeated suggestions in this country that the United States extend aid to the Latin republics in matters of road improvement by the loan of trained engineers as advisers.

Mr. James has served with the Bureau of Public Roads since 1910. He was technical adviser to the American delegation to the International Trade Conference on Automobile Traffic in Paris in 1926, and was secretary of the Joint Board of Federal and State Highway Officials which planned and arranged for the marking of the United States highway system. He is a graduate of Harvard University and the Massachusetts Institute of Technology, and is a member of the American Society of Civil Engineers and the American Association of State Highway Officials.

## Personal Notes

MARK D. EWELL, of Fulton, N. Y., has been appointed by the Board of Supervisors county superintendent of highways for Oswego County, succeeding the late E. A. Howard. He stood third on the list at the recent examination. Mr. Ewell has been employed by large engineering and contracting firms and has done much work in the country on bridge and road contracts.

LESLIE H. DODD, of Lawrence, Kan., has been added to the field staff of the American Institute of Steel Construction as assistant engineer, with headquarters at Dallas, Tex. Mr. Dodd, a graduate of the University of Kansas, has served for several years as chief engineer for a Western construction company, designing and constructing large buildings.

R. H. BAKER, of Nashville, has been appointed commissioner of highways and public works by Gov. Henry H. Horton of Tennessee to succeed Harry S. Berry, who was appointed to the position about a year ago but who was recently removed from office by the Governor because of differences between them in regard to the construction of a road in Chester County.

THERON W. RAGSDALE, of Dallas, Tex., who has recently been employed on the construction of the levee system of the City and County of Dallas Levee Improvement District at Dallas, has been appointed associate engineer, chief of supply section, in the U. S. Engineer Office, Vicksburg, Miss. Previously Mr. Ragsdale was with Myers, Noyes & Forrest, consulting engineers, Dallas, Tex., on levee and irrigation projects in Texas.

CHARLES A. CLARK, of Dallas, Tex., has been appointed manager of the Southwestern offices of the Portland Cement Association, with headquarters at Kansas City, succeeding Forest Kaufman, resigned. Mr. Clark was concrete inspector on the over-sea railway extension of the Florida East Coast Railway from the mainland to Key West and was later active in the development of the model highway system of Illinois. He joined the staff of the Portland Cement Association in 1917.

R. J. S. PIGOTT, who for three years was mechanical engineer with Stevens & Wood, Inc., and later consulting engineer with the Public Service Corporation of New Jersey Production Company and the Smoot Engineering Corporation, has returned to the Stevens & Wood organization as consulting mechanical engineer.

P. L. COLEMAN, of St. Louis, Mo., who has recently been associated with the firm of Montgomery & Ward, Wichita Falls, Tex., has been appointed assistant resident engineer in charge of highway and bridge construction in Knox County, for the State Highway Department of Texas. Mr. Coleman was formerly supervising engineer for the Mellon Construction Company, of Pittsburgh, Pa.

GEORGE M. SHEPARD, engineer for the Northern States Contracting Company since his resignation as city engineer of St. Paul in August, 1927, has resigned as a member of the Metropolitan Drainage Commission, which has been studying the sewage-disposal problem of St. Paul and Minneapolis. The City Council of St. Paul, which has the appointment of one member on this commission, has appointed JOHN W. KELSEY, present city engineer, to succeed Mr. Shepard.

## Engineering Societies

### CALENDAR

ANNUAL MEETINGS

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; spring meeting, Dallas, Tex., April 24-26.

AMERICAN WELDING SOCIETY, New York; annual meeting, New York City, April 24-26.

NATIONAL FIRE PROTECTION ASSOCIATION, Boston; annual convention, Memphis, Tenn., May 13-16.

AMERICAN WATER WORKS ASSOCIATION, New York; annual meeting, Toronto, Canada, June 24-28.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; annual meeting, Mexico City, Aug. 26-28.

* * *

THE NORTHEASTERN SECTION, Am. Soc.C.E., at its annual meeting in Boston elected the following officers for the ensuing year: President, R. K. Hale; vice-president, L. C. Wason; secretary-treasurer, C. W. Banks.

## Obituary

FRANCIS CARLILE TUCKER, engineer, prominently identified with railroad building in the Northwest and with other construction enterprises East and West, died on Feb. 10 at Longwood, Fla., at the age of 85. He began his professional career in Boston, where he was employed in construction of the Boston water-works and in general practice. For 25 years he was resident engineer on the Northern Pacific, the Burlington and other Western railroads.

GEORGE B. CORNELL, one of the oldest members of the American Society of Civil Engineers and for years one of the leading civil and mechanical engineers in the New York district, died on March 14. He was 74 years old. Upon his graduation from Columbia University in 1877 Mr. Cornell became an assistant engineer on the Brooklyn Elevated Railway. Subsequently he went to the New York, Chicago & St. Louis Railway as an assistant engineer and then to the Rochester & Pittsburgh Railway as locating engineer. Following this engagement Mr. Cornell was, for a time, in the bridge department of the West Shore & Buffalo Railway before returning to the Brooklyn Elevated, eventually to become its chief engineer. In later life he became consultant to many utility corporations and for years was associated with the New York Edison Electric Company in an advisory capacity. Mr. Cornell joined the American Society of Civil Engineers as a junior in 1879.

## Cost and Contracts

### E. N.-R. Index Numbers

| Cost | | Volume | |
|---|---|---|---|
| **Mar. 1, 1929** | **207.78** | **February, 1929** | **328** |
| Feb. 1, 1929 | 210.40 | January, 1929 | 325 |
| Mar. 1, 1928 | 204.65 | February, 1928 | 225 |
| Average, 1928 | 206.78 | Average, 1928 | 287 |
| Average, 1927 | 206.24 | Average, 1927 | 263 |
| 1913 | 100.00 | 1913 | 100 |

### This Week's Contracts

Heavy construction contracts, reported by *Engineering News-Record* in the week of March 21, with some comparisons, total as follows:

(In Thousands of Dollars)

| | Mar. 21, 1929 | Mar. 14, 1929 | Mar. 22, 1928 |
|---|---|---|---|
| Building: | | | |
| Industrial | $9,295 | $10,524 | $17,775 |
| Commercial | 36,215 | 98,535 | 34,966 |
| Streets and roads | 4,352 | 5,159 | 12,197 |
| Other eng. constr. | 6,061 | 46,698 | 10,600 |
| Total | $55,923 | $160,916 | $75,538 |
| Total, all classes, Jan. 1 to Mar. 21: | | | |
| 1929 | | | $1,056,683 |
| 1928 | | | 689,759 |

# Construction Equipment and Materials

## New England Road Show

The fifth annual open air show of roadbuilders' machinery will be held May 7-9, in Cambridge, Mass. The same location as formerly, at Memorial Drive and Cottage Farm bridge, will be used. The show is under the auspices of the Massachusetts Highway Association, F. W. Mattheis, 285 Dorchester Ave., Boston, being in charge of exhibit space. It is stated that space is available for more than 100 exhibitors.

## Locomotive Motors Equipped With Roller-Bearing Armatures

Each of the eight motors on the Baldwin-Westinghouse motor generator locomotives used in the new Cascade tunnel of the Great Northern Railroad is equipped with Norma-Hoffman roller bearings to carry its 3,730-lb. armature, which is mounted on a 6-in. shaft. This is believed to be one of the largest roller-bearing installations yet made. A ball bearing at one end takes care of shaft location. The eight motors have a combined horsepower, one-hour rating, of 4,330, and a tractive effort of 112,600 lb.

## Business Notes

J. D. Adams Company, Indianapolis, Ind., has established a new branch office and warehouse in Atlanta to serve its Georgia territory. Previously the company's equipment has been sold in Georgia by distributors, but this equipment is now sold and serviced by factory representatives working out of the Atlanta branch.

Berger Manufacturing Company, Canton, Ohio, manufacturer of products made from steel sheets such as metal ceilings, corrugated metal culverts and miscellaneous items, announces the appointment of J. S. Sprott as its general manager of sales. Mr. Sprott graduated in civil engineering at Purdue University and entered sales work in 1913, and has for the past eight years been vice-president in charge of sales of the General Fireproofing Company, Youngstown, Ohio.

Ludlum Steel Company, Watervliet, N. Y.; Central Alloy Steel Corporation, Massillon, Ohio, and Firth-Sterling Steel Company, McKeesport, Pa., are some of the American companies that have been licensed by the Krupp Nirosta Company, Inc., to manufacture a new stainless steel known as Nirosta steel. The steel was perfected by the Krupps at Essen, Germany, utilizing a special heat treatment for chrome nickel steel of certain analyses. Krupp Nirosta Company, Inc., has been incorporated in the United States under the laws of Delaware with H. G. Batcheller, vice-president of Ludlum Steel Company, as its president. Sub-licenses have been granted to Lukens Steel Company, which will obtain the material in the form of slabs and roll it into plates; the Babcock & Wilcox Tube Company, which will manufacture tubes; and Spang, Chalfont & Company, which will manufacture pipe.

George D. Whitcomb Company, Rochelle, Ill., announces that the Baldwin Locomotive Works, Philadelphia, has purchased a substantial interest in its business. The Whitcomb company has been established for 50 years and has developed a complete line of gasoline, distillate, oil and alcohol burning locomotives for railway switching as well as industrial and contracting activities. The Baldwin Locomotive Works will sell Whitcomb locomotives and products in practically all foreign countries and will handle the railway field in the United States for the Whitcomb company.

George M. Darby has been appointed assistant manager of the development department of the Dorr Company, New York City. Mr. Darby has been with the Dorr Company since 1920. As chief chemist he has had charge of many important research problems for the company.

James S. Watson has been elected vice-president of the Link-Belt Company, with headquarters at the company's Dodge works in Indianapolis, Ind. Mr. Watson has been with the Link-Belt Company continuously for 34 years. In January, 1903, after eight years' experience in various departments, he was selected to take charge of the exploitation of the company's silent chain as a power-transmitting medium. For the past nine years Mr. Watson has been located at the company's Dodge works, of which he is general manager in full charge of production of silent and roller chain drives.

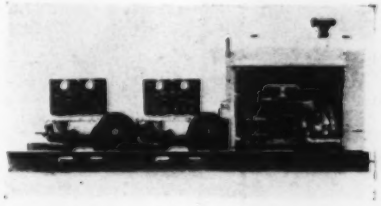
American Hoist & Derrick Company, St. Paul, Minn., announces the opening of a branch office at 139 Townsend St., San Francisco, Calif. The establishment of this office terminates the connection with Harron, Rickard & McCone, who handled the company's equipment in San Francisco for a great many years. Boyd Nixon has been placed in charge of the new office. The company also announces the appointment of F. E. Bauer, Jr., as export sales manager, with offices at 50 Church St., New York City.

William H. Ziegler Company, Minneapolis, Minn., is opening a branch office in Fargo, N. D., in charge of O. H. Strand. Among the accounts which will be handled are Barber-Greene, Bucyrus-Erie, Chain Belt, Sterling Wheelbarrow, Williams Bucket, Plymouth Locomotive and Butler Bin.

## New Developments

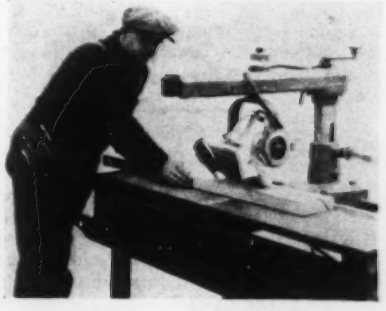
### Twin Generator Welding Set

A new development in arc-welding equipment has been announced by the Electric Arc Cutting & Welding Company, Newark, N. J., in the form of a twin generator set powered by a Continental 40-hp. engine, as shown in the accompanying illustration. Each of the generators is rated at 300 amp. for metallic arc welding and can be increased to obtain full capacity for carbon arc welding if desired.



### New Electric Woodworking Unit Made in Smaller Size

As an addition to its line of heavy-duty electric woodworkers, the DeWalt Products Corporation, Leola, Pa., announces a new model to be known as the DeWalt Junior. The smaller model incorporates such features of the large model, known as the "Wonder-Worker," as guided power applied to the saw in all cutting positions, instant change from crosscutting to ripping without stopping the motor, an accurate ripping gage and dials for adjustment to any position. The motor operates from any cycle in either alternating or direct current by plugging in the nearest light socket. It is said that this machine will handle accurately 29 distinct cutting operations. The attach-



ment of the necessary cutting tool, which is the work of a moment's time, adapts the unit to another cutting job. All work is handled from the same side of the table. The table is 29x59 in. and together with the complete machine weighs 235 lb. It can thus be easily carried by two men to be set up on a pair of horses or moved about on a movable truck. Standard equipment includes an adjustable guard that fits down to the work and gives positive protection to the operator. This guard is shown to good advantage in the accompanying illustration.

### Heavy-Duty Truck Body Tapers From Front to Rear

Truck operators in the contracting and building supply business can now be supplied with a line of standard dump bodies covering the major portion of dump truck activities from Mack Trucks, Inc., New York City. The new

bodies are built of No. 7 gage sheet steel, and are constructed to taper 4 in. from front to rear, a feature which is said to insure rapid emptying of the body, even with sticky material. The bodies have full-length 6-in. running boards with round corner front, which supplies a smooth rub rail the full length of the body and also a substantial front corner body bumper. Front headboard, tailgate posts and gate all extend well above the body sides proper so that sideboard extension and large opening tailgate are provided for. The bodies all have manual tailgate operation and are also equipped with double-acting tailgate as standard equipment. As may be seen in the accompanying illustration, the underside of the bodies is substantially braced to eliminate bottom waving as much as possible.

### Automatic Operations on New 27-E Paver

The new 27-E paver which has been introduced by the Koehring Company, Milwaukee, is said to be a completely new machine and not a redesign of its 1928 model. Automatic operations on the new paver have brought a complete mixing cycle, including charging and discharging, down to 69 seconds, with a one-minute period allowed for mixing, according to the manufacturer. The operator's only task is to lower the skip and operate the bucket control lever.

Ball and roller bearings are used throughout the power transmission line

as well as in idler sheaves and on the drum and bucket rollers. All gear units are inclosed and operated in oil. Heavy-duty construction is used in every part of the paver. Each operating unit—drum, skip hoist, motor and the entire power transmission line—is completely protected by mounting on rigid castings with three-point suspension and by flexible couplings or flexible means of power transmission.

With a total maximum height of only 11 ft. 3 in. and weight of 22 tons, which is evenly distributed, the new machine has an unusually low center of gravity. The Koehring power steering mechanism is retained. Two steering levers are used as controls. The new power plant is a six-cylinder Waukesha gasoline engine. It is said that provision has been made for handling drier mixes and special concretes by making the mixing drum of ample size and by special arrangement of the pickup buckets and throwover blades. A bulletin describing the new paver in detail is available from the Koehring Company.

## New Publications

*Concrete Admixture* — AMERICAN TRIPOLI COMPANY, a subsidiary of the Barnsdall Corporation, St. Louis, Mo., has published a bulletin describing its Barnsdall Admix, a finely ground, metacolloidal tripoli silica. The bulletin describes the admixture, giving its various uses and advantages, also tables of its physical and chemical properties, specifications and instructions for its use and a number of pages of results of tests made by various testing laboratories on concrete specimens incorporating the admixture. Photographs are given of some of the structures upon which concrete utilizing the admixture has been used and a partial list of such structures is given.

*Buckets*—OWEN BUCKET COMPANY, Cleveland, Ohio, has published two new booklets describing its two new model buckets, the type S, a rehandling bucket, and the type D, a heavy-duty digging bucket. The type S bucket is made in standard, heavy and special models. The text and illustrations describe some of their special characteristics, such as one-piece steel crosshead, concentration of weight on the centershaft, sealed centershaft bearings and long-life sheaves and cables due to a special method of mounting on the main counterweight. These characteristics are also discussed for the type D heavy-duty bucket, and in addition this bucket incorporates a patented method of stopping the jaws at a fixed open position in order to absorb dropping shocks.

*Lamella Roof Construction* — NATIONAL LUMBER MANUFACTURERS ASSOCIATION, Washington, D. C., has published a 30-page illustrated booklet covering standard practice in the erection of trussless roof structures, utilizing the Lamella type of construction which has been used on the Houston convention hall built for the Democratic national convention and other large structures, such as warehouses, garages, auditoriums, gymnasiums, skating rinks, armories, recreation halls, airplane hangars and large barns. The new booklet traces the origin of the design, illustrates its methods and principal advantages, discusses its application to certain classes of buildings and lists structures in America that have used the design.

*Accessories for Movable Bridges*—NORWOOD-NOONAN COMPANY, Chicago, has issued revised bulletins for its loose-leaf catalog. These include inclosed gasoline engines for use in exposed places, roadway signal lamps and warning bells, colors and dimensions of bridge and pier lamps, and electric switches to limit the movement of drawbridges and control the operation of their locks and signals.

*Gas-Electric Locomotives* — MACK TRUCKS, INC., New York City, has devoted its catalog R-91 to descriptions and specifications of its gas-electric rail cars and locomotives.

*Airplane Hangars*—MACOMBER STEEL COMPANY, Canton, Ohio, has published a revised catalog of its hangar designs for airports, designs based upon the use of Masillon standardized steel building products. Although the designs utilize standard products of the company, the catalog states: "There is no place and never will be a place in the aviation industry for standard hangars that can be bought on a mail order basis. Each is a separate design problem." Various factors considered in the designs as given in the catalog are the structural framework of the hangar, side wall construction and requirements for fireproofing, roof decking, floors and hangar doors. Numerous illustrations are given of the company's hangars in use and in the course of construction, and several line drawings are included showing typical details.

## Manufacturers and Trade Associations

### CALENDAR

ANNUAL MEETINGS

CONCRETE REINFORCING STEEL INSTITUTE, Chicago; annual convention, Asheville, N. C., April 15-17.